THE

POPULAR SCIENCE MONTHLY.

JUNE, 1888.

THE SURPLUS REVENUE.

By EDWARD ATKINSON.

IS the United States now in receipt of a revenue derived from taxation in excess of a reasonable expenditure for conducting the functions of the Government and meeting the current annual expenses of the nation, the pensions and other like obligations already incurred?

To this question a positive answer may be given. Yes. The surplus revenue of the United States, above the necessary expenses of the Government economically administered, is now at least $100,000,000 a year; and unless Congress at its present session takes some action for the reduction of the revenue, it may exceed ere long $150,000,000 each year.

On the other hand, it may be asked, Would a private corporation consider itself in possession of a surplus revenue from its business, which it would be at liberty to deal with at its own pleasure, *if* it owed a large sum of money on demand and a still larger sum of money subject to be paid on demand within a short period of time? No sound business man could be found who would affirm that under such conditions a private corporation could make any more suitable use of the revenue received in excess of its necessary expenditure than to apply it to the payment of its debt due on demand, and to prepare the way for making payment of the debt soon to become due at a date fixed.

If this reasoning be applied to the present condition of the United States, it will appear that the Government is *not* at the present time in the possession of a surplus revenue in any true sense. It owes on demand that sum of money which is represented by the evidences of debt, known as *legal-tender notes*, and commonly called *greenbacks*.

In order to be able to pay these notes on demand when demand is made, the treasury of the United States holds a special reserve of $100,000,000 in gold coin; but the amount of notes due is in round figures $350,000,000. The United States, therefore, owes substantially $250,000,000 on demand, for which it has as yet made no specific provision either in gold coin or to any considerable extent, even in silver coin which can be made available for such payments. The remainder of its gold held in the treasury above the special reserve of $100,000,000 is either subject to payment on demand in liquidation of gold certificates of deposits, or else it constitutes a part of the necessary daily balance of money necessary to the ordinary conduct of business. The larger part, if not the whole, of the silver dollars held by the treasury are held to meet the payment of the silver certificates which have been issued against them. There are, therefore, substantially $250,000,000 of United States notes due on demand, for which no specific provision has yet been made and to the payment of which the so-called surplus revenue could now be applied. Yet the public mind has become so accustomed to the common use of a debt currency, which under a fiction of law has been declared to be lawful money by the Supreme Court of the United States, as to have lost sight of the fact that the greenback or legal-tender note is not true money, but that it is an evidence of debt to be paid. Therefore, no consideration is given to the possible application of surplus revenue, so called, to such payment of these notes now due on demand.

In order that this subject may be made clear, it becomes necessary to recur once more to the original purpose of the Government in issuing United States notes and compelling their acceptance as lawful money by means of the legal-tender act. *These notes were issued in time of war for the purpose of collecting a forced loan and for no other purpose.* The necessity for a forced loan has ceased; the revenue of the Government is in excess of its necessary expenditures. When the revenue derived from taxation is paid to the Government in its own notes, that forced loan, to the amount of such notes paid in, has been liquidated by way of taxation. Each note returned to the treasury in settlement of a tax becomes like a common bank-note when redeemed by the bank; it is a note paid. It is *functus officio.* Its reissue by the treasury of the United States is in fact the collection of *a new forced loan* without authority of law under any act authorizing such a new loan, without necessity, without benefit to any one, and with positive danger to the whole community.

If the executive officers of the United States were to take the ground that these notes should not be reissued when they had once been paid into the treasury of the United States in settle-

ment of a tax, except under a specific act of Congress authorizing the collection of a new loan—i. e., without an act being now passed authorizing a new loan of money, for which purpose a specific act is required on the part of Congress under the existing statutes—could Congress itself compel the Executive to reissue these notes even as the laws now stand? Could Congress meet the case by a mere mandatory act, instructing the treasurer to reissue the notes, without passing an act for borrowing money or for negotiating a new loan on the terms named in these notes?

If not, then, so far as the excess of revenue received by the treasury of the United States over and above its necessary expenditures under the appropriations made by Congress consists of legal-tender notes, such notes cease to be money when they come back into the treasury. They no longer constitute a surplus; they are simply evidences of a demand debt which has been paid.

What objection is there to this course being taken? Simply this: Under a fiction of law, sustained by a decision of the Supreme Court, these evidences of debt have become a part of the circulating medium—i. e., a part of that which is used as money in that portion of the transactions of the people in which actual money is required; also, under the provisions of the bank act, these notes may constitute a part of the bank reserves held by them to meet their obligations when demand is made upon them for payment in money. Why should banks not be required to hold coin only for that purpose?

Upon what ground can a rich and prosperous nation hold to the belief that it can not afford to pay its debt due on demand lest it should be unable to supply itself with real money in place of this mock-money which has been forced into circulation under the stress of war and under an alleged necessity which has ceased? The instruments of exchange or currency which serve the purpose of money in the United States now consist of seven different kinds, viz., gold coin of full legal tender; Government certificates of gold coin; silver dollars of full legal tender; Government certificates payable in silver dollars; legal-tender notes redeemable on demand and receivable for taxes; national-bank notes convertible on demand into lawful money on presentation at the banks; subsidiary coin of limited legal tender.

The proportion of the transactions of the country in which actual money of either of these seven kinds is necessarily used, constitutes but a very small fraction of the transactions of all kinds. A vast proportion, far exceeding ninety per cent of all the transfers, bargains, sales of goods, stock, and real estate, are liquidated and settled by the use of checks, bills of exchange

and book accounts, without recourse to any actual money whatever. The money itself is used as an instrument only in the petty transactions of life. Yet such is the delusion regarding the necessity for a certain quantity of real or coined money, or for substitute money redeemable in coin, to be kept in actual circulation, that a panic nearly happened last summer because it was assumed that an undue proportion of these various kinds of money or currency would be called into the treasury and would not be reissued for lack of appropriations. Even the most sagacious bankers then appealed to the treasury for relief, as if this country did not hold a demand check upon the reserves of gold coin throughout the world sufficient to meet any such temporary difficulty! The panic was allayed, but allayed only by the very judicious action of the Treasury Department; but the cause of the panic was very soon *removed* by the import of over $30,000,000 in gold coin in response to our drafts during the summer and early autumn.

The whole volume of the coin of the world is at our disposal if we choose to draw upon it as we did last summer. If right consideration be given to existing conditions there could perhaps be no better use for the excess of revenue derived by Government from taxation than its application to the payment of that part of the demand debt, to wit, $250,000,000, which is not now covered by gold in the treasury. There could then be no objection to the continued circulation of United States notes in place of the coin itself; their form could be changed; they could be made into gold certificates corresponding to the silver certificates. Then the whole financial system of the country would be placed upon a solid foundation such as it had never before reached. If such a course were adopted, the excess of revenue over necessary expenses and probable appropriations by the present Congress would be likely to amount to about the sum of uncovered notes, viz., $250,000,000, in the interval between the present time and the time when the four and a half per cent bonds would become due and payable in 1891. Any excess of revenue at that time could then be applied to the payment of such four and a half per cent bonds. Is it not a financial absurdity to buy bonds not yet due at a high premium, and to make a forced loan by the issue of notes due on demand for that purpose?

It may, therefore, be time enough to shape legislation *on the mere ground of an alleged excess of revenue*, when the legal-tender notes and the four and a half per cent bonds shall all have been paid, and not before.

There may be other reasons for reducing taxation. The purpose of this memorandum is simply to treat the alleged excess of revenue and to show that there is as yet none above the positive

obligations of the Government which are due and payable. The purpose is to bring out the fact that there is a debt of the United States now due which can be paid; that the country is rich enough to pay it; that no financial disturbance would of necessity ensue; that the vast deposits of gold coin now held in Europe and our own annual product would suffice to meet our checks for $200,000,000, without serious embarrassment, to be used in the next two or three years, in liquidation of the balance due us for cotton, for corn, and for other commodities which the world must have and can not spare.

It therefore follows that if any temporary financial stringency should occur because of the withdrawal of the legal-tender notes from the bank reserves and from their use as money in this country, the burden or strain of that condition need not and would not be carried by the banks or bankers of this country, but would be transferred to our debtors who owe us, and will continue to owe us annually, on our merchandise account, more than we require to put ourselves on the most solid financial foundation of any nation in the world, viz., on a basis of a paper currency based upon actual bullion held in reserve, dollar for dollar. If it be said that such a demand for coin on the bank reserves of Europe would be met by a return of our securities, may it not be held that these securities are mostly held for investment, and that the more apparent the danger of war and of financial disturbance in Europe becomes, the larger will be the transfer of capital to this country for investment?

May it not be held that the very excess of revenue paid into the treasury over and above the necessities of the Government, is in itself a witness to the enormous financial power now held by the United States because of the very accumulation of capital which has occurred during the last few years? May we not be misled by a mere delusion in assuming that the legal-tender notes or greenbacks have any further useful function in this country if they ever had any?

When the fact is baldly stated which can not be denied, that the reissue of these notes from the treasury of the United States is not the continuance of a former loan, but is the actual borrowing of new money under a forced loan and in time of peace, can anything be more absurd than to assume that such a course is necessary? If the burden of taxation demands relief, that is altogether another matter. If, on the other hand, the burden of taxation is not serious, to what better purpose can the revenue be put than to the payment of any or all debts of the United States, to the end that, before the century is completed, the United States may be absolutely free from the debt which it incurred in order to maintain the integrity of the nation?

A COUNTER CRITICISM.

By HERBERT SPENCER.

WHILE I do not concur in sundry of the statements and conclusions contained in the article entitled "A Great Confession," contributed by the Duke of Argyll to the last number of this Review,* yet I am obliged to him for having raised afresh the question discussed in it. Though the injunction "Rest and be thankful," is one for which in many spheres much may be said—especially in the political, where undue restlessness is proving very mischievous—yet rest and be thankful is an injunction out of place in science. Unhappily, while politicians have not duly regarded it, it appears to have been taken to heart too much by naturalists; in so far, at least, as concerns the question of the origin of species.

The new biological othodoxy behaves just as the old biological orthodoxy did. In the days before Darwin, those who occupied themselves with the phenomena of life passed by with unobservant eyes the multitudinous facts which point to an evolutionary origin for plants and animals; and they turned deaf ears to those who insisted upon the significance of these facts. Now that they have come to believe in this evolutionary origin, and have at the same time accepted the hypothesis that natural selection has been the sole cause of the evolution, they are similarly unobservant of the multitudinous facts which can not rationally be ascribed to that cause; and turn deaf ears to those who would draw their attention to them. The attitude is the same; it is only the creed which has changed.

But, as above implied, though the protest of the Duke of Argyll against this attitude is quite justifiable, it seems to me that many of his statements cannot be sustained. Some of these concern me personally, and others are of impersonal concern. I propose to deal with them in the order in which they occur.

On page 144† the Duke of Argyll quotes me as omitting "for the present any consideration of a factor which may be distinguished as primordial"; and he represents me as implying by this "that Darwin's ultimate conception of some primordial 'breathing of the breath of life' is a conception which can only be omitted 'for the present.' Even had there been no other obvious interpretation, it would have been a somewhat rash assumption that this was my meaning when referring to an omit-

* See "Popular Science Monthly" for May, 1888.

† "Popular Science Monthly," vol. xxxiii, p. 57.

ted factor; and it is surprising that this assumption should have been made after reading the second of the two articles criticised, in which this factor omitted from the first is dealt with; this omitted third factor being the direct physico-chemical action of the medium on the organism. Such a thought as that which the Duke of Argyll ascribes to me, is so incongruous with the beliefs I have in many places expressed that the ascription of it never occurred to me as possible.

Lower down on the same page are some other sentences having personal implications, which I must dispose of before going into the general question. The Duke says "it is more than doubtful whether any value attaches to the new factor with which he [I] desires to supplement it" [natural selection]; and he thinks it "unaccountable" that I "should make so great a fuss about so small a matter as the effect of use and disuse of particular organs as a separate and a newly recognised factor in the development of varieties." I do not suppose that the Duke of Argyll intended to cast upon me the disagreeable imputation, that I claim as new that which all who are even slightly acquainted with the facts know to be anything rather than new. But his words certainly do this. How he should have thus written in spite of the extensive knowledge of the matter which he evidently has, and how he should have thus written in presence of the evidence contained in the articles he criticises, I cannot understand. Naturalists, and multitudes besides naturalists, know that the hypothesis which I am represented as putting forward as new is much older than the hypothesis of natural selection—goes back at least as far as Dr. Erasmus Darwin. My purpose was to bring into the foreground again a factor which has, I think, been of late years improperly ignored; to show that Mr. Darwin recognised this factor in an increasing degree as he grew older (by showing which I should have thought I sufficiently excluded the supposition that I brought it forward as new); to give further evidence that this factor is in operation; to show there are numerous phenomena which cannot be interpreted without it; and to argue that if proved operative in any cases, it may be inferred that it is operative on all structures having active functions.

Strangely enough, this passage in which I am represented as implying novelty in a doctrine which I have merely sought to emphasise and extend, is immediately succeeded by a passage in which the Duke of Argyll himself represents the doctrine as being familiar and well established:

> That organs thus enfeebled [i. e. by persistent disuse] are transmitted by inheritance to offspring in a like condition of functional and structural decline, is a correlated physiological doctrine not generally disputed. The converse case—

of increased strength and development arising out of the habitual and healthy use of special organs, and of the transmission of these to offspring—is a case illustrated by many examples in the breeding of domestic animals. I do not know to what else we can attribute the long slender legs and bodies of greyhounds so manifestly adapted to speed of foot, or the delicate powers of smell in pointers and setters, or a dozen cases of modified structure effected by artificial selection.

In none of the assertions contained in this passage can I agree. Had the inheritance of "functional and structural decline" been "not generally disputed," half my argument would have been needless; and had the inheritance of "increased strength and development" caused by use been recognised, as "illustrated by many examples," the other half of my argument would have been needless. But both are disputed; and, if not positively denied, are held to be unproved. Greyhounds and pointers do not yield valid evidence, because their peculiarities are more due to artificial selection than to any other cause. It may, indeed, be doubted whether greyhounds use their legs more than other dogs. Dogs of all kinds are daily in the habit of running about and chasing one another at the top of their speed—other dogs more frequently than greyhounds, which are not much given to play. The occasions on which greyhounds exercise their legs in chasing hares occupy but inconsiderable spaces in their lives, and can play but small parts in developing their legs. And then, how about their long heads and sharp noses? Are these developed by running? The structure of the greyhound is explicable as a result mainly of selection of variations occasionally arising from unknown causes; but it is inexplicable otherwise. Still more obviously invalid is the evidence said to be furnished by pointers and setters. How can these be said to exercise their organs of smell more than other dogs? Do not all dogs occupy themselves in sniffing about here and there all day long: tracing animals of their own kind and of other kinds? Instead of admitting that the olfactory sense is more exercised in pointers and setters than in other dogs, it might, contrariwise, be contended that it is exercised less; seeing that during the greater parts of their lives they are shut up in kennels where the variety of odors, on which to practise their noses, is but small. Clearly if breeders of sporting dogs have from early days habitually bred from those puppies of each litter which had the keenest noses (and it is undeniable that the puppies of each litter are made different from one another, as are the children in each human family, by unknown combinations of causes), then the existence of such remarkable powers in pointers and setters may be accounted for; while it is otherwise unaccountable. These instances, and many others such, I

should have gladly used in support of my argument had they been available; but unfortunately they are not.

On the next page of the Duke of Argyll's article (page 145), occurs a passage which I must quote at length before I can deal effectually with its various statements.* It runs as follows:

> But if natural selection is a mere phrase, vague enough and wide enough to cover any number of the physical causes concerned in ordinary generation, then the whole of Mr. Spencer's laborious argument in favor of his "other factor" becomes an argument worse than superfluous. It is wholly fallacious in assuming that this "factor" and "natural selection" are at all exclusive of, or even separate from, each other. The factor thus assumed to be new is simply one of the subordinate cases of heredity. But heredity is the central idea of natural selection. Therefore natural selection includes and covers all the causes which can possibly operate through inheritance. There is thus no difficulty whatever in referring it to the same one factor whose solitary dominion Mr. Spencer has plucked up courage to dispute. He will never succeed in shaking its dictatorship by such a small rebellion. His little contention is like some bit of Bumbledom setting up for Home Rule—some parochial vestry claiming independence of a universal empire. It pretends to set up for itself in some fragment of an idea. But here is not even a fragment to boast of or to stand up for. His new factor in organic evolution has neither independence nor novelty. Mr. Spencer is able to quote himself as having mentioned it in his *Principles of Biology*, published some twenty years ago; and by a careful ransacking of Darwin he shows that the idea was familiar to and admitted by him at least in his last edition of the *Origin of Species*. . . . Darwin was a man so much wiser than all his followers, &c.

Had there not been the Duke of Argyll's signature to the article, I could scarcely have believed that this passage was written by him. Remembering that on reading his article in the preceding number of this Review, I was struck by the extent of knowledge, clearness of discrimination, and power of exposition, displayed in it, I can scarcely understand how there has come from the same pen a passage in which none of these traits are exhibited. Even one wholly unacquainted with the subject may see in the last two sentences of the above extract, how strangely its propositions are strung together. While in the first of them I am represented as bringing forward a "new factor," I am in the second represented as saying that I mentioned it twenty years ago! In the same breath I am described as claiming it as new and asserting it as old! So, again, the uninstructed reader, on comparing the first words of the extract with the last, will be surprised on seeing in a scientific article statements so manifestly wanting in precision. If "natural selection is a mere phrase," how can Mr. Darwin, who thought it explained the origin of species, be regarded as wise? Surely it must be more than a mere phrase if it is the key to so many

* "Popular Science Monthly," vol. xxxiii, p. 58.

otherwise inexplicable facts. These examples of incongruous thoughts I give to prepare the way; and will now go on to examine the chief propositions which the quoted passage contains.

The Duke of Argyll says that "heredity is the central idea of natural selection." Now it would, I think, be concluded that those who possess the central idea of a thing have some consciousness of the thing. Yet men have possessed the idea of heredity for any number of generations and have been quite unconscious of natural selection. Clearly the statement is misleading. It might just as truly be said that the occurrence of structural variations in organisms is the central idea of natural selection. And it might just as truly be said that the action of external agencies in killing some individuals and fostering others is the central idea of natural selection. No such assertions are correct. The process has three factors—heredity, variation and external action—any one of which being absent the process ceases. The conception contains three corresponding ideas, and if any one be struck out the conception cannot be framed. No one of them is the central idea, but they are coessential ideas.

From the erroneous belief that "heredity is the central idea of natural selection" the Duke of Argyle draws the conclusion, consequently erroneous, that "natural seclection includes and covers all the causes which can possibly operate through inheritance." Had he considered the cases which, in the *Principles of Biology*, I have cited to illustrate the inheritance of functionally-produced modifications, he would have seen that his inference is far from correct. I have instanced the decrease of the jaw among civilised men as a change of structure which cannot have been produced by the inheritance of spontaneous, or fortuitous, variations. That changes of structure arising from such variations may be maintained and increased in successive generations, it is needful that the individuals in whom they occur shall derive from them advantages in the struggle for existence—advantages, too, sufficiently great to aid their survival and multiplication in considerable degrees. But a decrease of jaw, reducing its weight by even an ounce (which would be a large variation), cannot, by either smaller weight carried or smaller nutrition required, have appreciably advantaged any person in the battle of life. Even supposing such diminution of jaw to be beneficial (and in the resulting decay of teeth it entails great evils), the benefit can hardly have been such as to increase the relative multiplication of families in which it occurred generation after generation. Unless it has done this, however, decreased size of the jaw cannot have been produced by the natural selection of favorable variations. How can it then have

been produced? Only by decreased function—by the habitual use of soft food, joined, possibly, with the disuse of the teeth as tools. And now mark that this cause operates upon all members of a society which falls into civilised habits. Generation after generation this decreased function changes its component families simultaneously. Natural selection does not cover the case at all—has nothing to do with it. And the like happens in multitudinous other cases. Every species spreading into a new habitat, coming in contact with new food, exposed to a different temperature, to a drier or moister air, to a more irregular surface, to a new soil, &c., has its members one and all subject to various changed actions, which influence its muscular, vascular, respiratory, digestive, and other systems of organs. If there is inheritance of functionally-produced modifications, then all its members will transmit the structural alterations wrought in them, and the species will change as a whole without the supplanting of some stocks by others. Doubtless in respect of certain changes natural selection will co-operate. If the species, being a predaceous one, is brought, by migration, into the presence of prey of greater speed than before; then, while all its members will have their limbs strengthened by extra action, those in whom this muscular adaptation is greatest will have their multiplication furthered; and inheritance of the functionally-increased structures will be aided, in successive generations, by survival of the fittest. But it cannot be so with the multitudinous minor changes entailed by the modified life. The majority of these must be of such relative unimportance that one of them cannot give to the individual in which it becomes most marked, advantages which predominate over kindred advantages gained by other individuals from other changes more favorably wrought in them. In respect to these, the inherited effects of use and disuse must accumulate independently of natural selection.

To make clear the relations of these two factors to one another and to heredity, let us take a case in which the operations of all three may be severally identified and distinguished.

Here is one of those persons, occasionally met with, who has an additional finger on each hand, and who, we will suppose, is a blacksmith. He is neither aided nor much hindered by these additional fingers; but, by constant use, he has greatly developed the muscles of his arm. To avoid a perturbing factor, we will assume that his wife, too, exercises her arms to an unusual degree: keeps a mangle, and has all the custom of the neighborhood. Such being the circumstances, let us ask what are the established facts, and what are the beliefs and disbeliefs of biologists.

The first fact is that this six-fingered blacksmith will be likely to transmit his peculiarity to some of his children; and some of these, again, to theirs. It is proved that, even in the absence of a like peculiarity in the other parent, this strange variation of structure (which we must ascribe to some fortuitous combination of causes) is often inherited for more than one generation. Now the causes which produce this persistent six-fingeredness are unquestionably causes which "operate through inheritance." The Duke of Argyll says that "natural selection includes and covers all the causes which can possibly operate through inheritance." How does it cover the causes which operate here? Natural selection never comes into play at all. There is no fostering of this peculiarity, since it does not help in the struggle for existence; and there is no reason to suppose it is such a hindrance in the struggle that those who have it disappear in consequence. It simply gets cancelled in the course of generations by the adverse influences of other stocks.

While biologists admit, or rather assert, that the peculiarity in the blacksmith's arm which was born with him is transmissible, they deny, or rather do not admit, that the other peculiarities of his arm, induced by daily labor—its large muscles and strengthened bones—are transmissible. They say that there is no proof. The Duke of Argyll thinks that the inheritance of organs enfeebled by disuse is "not generally disputed"; and he thinks there is clear proof that the converse change—increase of size consequent on use—is also inherited. But biologists dispute both of these alleged kinds of inheritance. If proof of this is wanted, it will be found in the proceedings at the last meeting of the British Association, in a paper entitled "Are Acquired Characters Hereditary?" by Professor Ray Lankester, and in the discussion raised by that paper. Had this form of inheritance been, as the Duke of Argyll says, "not generally disputed," I should not have written the first of the two articles he criticises.

But supposing it proved, as it may hereafter be, that such a functionally-produced change of structure as the blacksmith's arm shows us is transmissible, the persistent inheritance is again of a kind with which natural selection has nothing to do. If the greatly-strengthened arm enabled the blacksmith and his descendants, having like strengthened arms, to carry on the battle of life in a much more successful way than it was carried on by other men, survival of the fittest would ensure the maintenance and increase in this trait in successive generations. But the skill of the carpenter enables him to earn quite as much as his stronger neighbor. By the various arts he has been taught, the plumber gets as large a weekly wage. The small shopkeeper by his foresight in buying and prudence in selling, the village

schoolmaster by his knowledge, the farm-bailiff by his diligence and care, succeed in the struggle for existence equally well. The advantage of a strong arm does not predominate over the advantages which other men gain by their innate or acquired powers of other kinds; and therefore natural selection cannot operate so as to increase the trait. Before it can be increased, it is neutralised by the unions of those having it with those having other traits. To whatever extent, therefore, inheritance of this functionally-produced modification operates, it operates independently of natural selection.

One other point has to be noted—the relative importance of this factor. If additional developments of muscle may be transmitted; if, as Mr. Darwin held, there are various structural modifications caused by use and disuse which imply inheritance of this kind; if acquired characters are hereditary, as the Duke of Argyll believes;—then the area over which this factor of organic evolution operates is enormous. Not every muscle only, but every nerve and nerve-centre, every blood-vessel, every viscus, and nearly every bone, may be increased or decreased by its influence. Excepting parts which have passive functions, such as dermal appendages and the bones which form the skull, the implication is that nearly every organ in the body may be modified in successive generations by the augmented or diminished activity required of it; and, save in the few cases where the change caused is one which conduces to survival in a pre-eminent degree, will be thus modified independently of natural selection. Though this factor can operate but little in the vegetal world, and can play but a subordinate part in the lowest animal world; yet, seeing that all the active organs of all animals are subject to its influence, it has an immense sphere. The Duke of Argyll compares the claim made for this factor to "some bit of Bumbledom setting up for Home Rule—some parochial vestry claiming independence of a universal empire." But, far from this, the claim made for it is to an empire, less indeed than that of natural selection, and over a small part of which natural selection exercises concurrent power, but of which the independent part has an area that is immense.

It seems to me, then, that the Duke of Argyll is mistaken in four of the propositions contained in the passages I have quoted. The inheritance of acquired characters *is* disputed by biologists, though he thinks it is not. It is not true that "heredity is the central idea of natural selection." The statement that natural selection includes and covers all the causes which can possibly operate through inheritance, is quite erroneous. And if the inheritance of acquired characters is a factor at all, the dominion it rules over is not insignificant but vast.

Here I must break off, after dealing with a page and a half of the Duke of Argyll's article. A state of health which has prevented me from publishing anything since *The Factors of Organic Evolution*, now nearly two years ago, prevents me from carrying the matter further. Could I have pursued the argument it would, I believe, have been practicable to show that various other positions taken up by the Duke of Argyll do not admit of effectual defence. But whether or not this is probable, the reader must be left to judge for himself. On one further point only will I say a word; and this chiefly because, if I pass it by, a mistaken impression of a serious kind may be diffused. The Duke of Argyll represents me as "giving up" the "famous phrase" "survival of the fittest," and wishing "to abandon it." He does this because I have pointed out that its words have connotations against which we must be on our guard, if we would avoid certain distortions of thought. With equal propriety he might say that an astronomer abandons the statement that the planets move in elliptic orbits, because he warns his readers that in the heavens there exist no such things as orbits, but that the planets sweep on through a pathless void, in directions perpetually changed by gravitation.

I regret that I should have had thus to dissent so entirely from various of the statements made and conclusions drawn by the Duke of Argyll, because, as I have already implied, I think he has done good service by raising afresh the question he has dealt with. Though the advantages which he hopes may result from the discussion are widely unlike the advantages which I hope may result from it, yet we agree in the belief that advantages may be looked for. How profound and wide-spreading are the consequences which may follow from the answer given to the question—"Are acquired characters hereditary?" I have pointed out in the preface to *The Factors of Organic Evolution* in its republished form; and perhaps I may be excused if I here reproduce the essential passages for the purpose of giving to them a wider diffusion:

"Though mental phenomena of many kinds, and especially of the simpler kinds, are explicable only as resulting from the natural selection of favorable variations; yet there are, I believe, still more numerous mental phenomena, including all those of any considerable complexity, which cannot be explained otherwise than as results of the inheritance of functionally-produced modifications. . . .

"Of course there are involved the conceptions we form of the genesis and nature of our higher emotions; and, by implication, the conceptions we form of our moral intuitions. . . .

"That our sociological beliefs must also be profoundly affected

by the conclusions we draw on this point, is obvious. If a nation is modified *en masse* by transmission of the effects produced on the natures of its members by those modes of daily activity which its institutions and circumstances involve; then we must infer that such institutions and circumstances mould its members far more rapidly and comprehensively than they can do if the sole cause of adaptation to them is the more frequent survival of individuals who happen to have varied in favorable ways.

"I will add only that, considering the width and depth of the effects which acceptance of one or other of these hypotheses must have on our views of Life, Mind, Morals, and Politics, the question—Which of them is true? demands, beyond all other questions whatever, the attention of scientific men."—*Nineteenth Century.*

THE PHILOSOPHY OF COMMERCIAL DEPRESSION.

By H. G. S. NOBLE.

IN seeking the explanation of highly complex phenomena, many simple and entirely inadequate causes are apt to be assigned by men who have become absorbed in them to the exclusion of other factors; and an ultimate comprehension of the problem is usually reached when some wide generalization, including many single causes, is found.

Thus, to account for the recurring waves of commercial depression to which the modern world is a prey, the bimetallist, the protectionist, the free-trader, and other specialists, urge their pet theories as individually sufficient; while in some far-reaching chain of influences, of which these are but necessary links, is probably to be found the complete cause. What follows is as much of an attempt as so brief a space will permit to find for these phenomena a generalization of this kind.

Life, or in more general terms the persistence of any organic aggregate, depends upon adaptation to surrounding circumstances. In the animal creation this adaptation is of two fundamental descriptions: first, the development of structures for the assimilation of nutriment; and, secondly, the development of structures for the obtainment of nutriment in competition with other organisms.

In the physical struggle, which grew more intense with the multiplication of organic forms, this second mode of adaptation reached its culmination in man. Indirectly, through the use of a more developed brain, the human being so employed the forces of Nature as to overcome the teeth and claws and brawn of his

animal rivals, and command the life-supporting products of the earth. These transcendent powers, by which the brute creation had been subjugated, men soon turned against each other, and the battle of life between man and man became as terrible as that between man and beast. But, unlike the fierce predatory mammals and the antediluvian monsters over which he had triumphed, the human animal soon ceased to carry on an isolated, individual, effort of self-preservation. Out of the early sexual association of mating, which he developed in common with many other creatures, there sprang the family, the tribe, and finally the nation. Co-operative organization was begun, from which has grown what we call civilized life.

The first grouping of many individuals into a tribe was the birth into the world of a new organism. This new organism has in the course of ages so grown, and developed, and differentiated in the complexity of its functions and structures, that it is recognized by modern philosophy; and the dawning study of the laws under which it lives constitutes the infant science of sociology.

We can not stop here to demonstrate this assertion, which the advanced thought of to-day has accepted and which the world at large is coming more and more to understand, that society, like the individuals of which it is made up, is an organism living by constant adaptation to its environment. To those who deny this, no inquiry into the main topic of our discussion is possible. Assuming it, therefore, to be a necessary postulate to all economic study, let us proceed to examine the character of that organism at the earliest stage of its growth.

The prehistoric human being, or unit with which the social structure was built, must have been, from our nineteenth-century standpoint, near akin to the brutes in the savageness of his instincts. Bred to a life of peril and physical conflict, the aggressive and predatory in his nature must have far exceeded any germs of those gentler attributes at present thought to be distinctively human. Now, as the nature of any whole must be determined by the aggregate natures of its component parts, the superorganic whole which the combination of these earlier individuals created must have displayed in a general way their common traits. In a word, the early tribe or germinal society was an aggressive, predatory organism, striving to perpetuate itself by the annihilation of all similar organisms with which it came into competition.

Why this fact is of importance to our discussion we can at once show. If all organisms perpetuate themselves by the adaptation of their structures to the particular circumstances of their lives, then a knowledge of these circumstances must be a key

to the structural peculiarities of any given organism. It follows, therefore, that if the earliest human societies lived, like the animal creation from which they were evolved, by an aggressive struggle with their neighbors, the fundamental social structure must have been one adapted to war.

Let us see if this is not the fact.

The first differentiation traceable in the savage tribes of all times is the rise to power of the strongest or ablest individual of the group, and the growing subordination to his authority of his followers. Along with this is traceable that change in the primitive instincts by which the individual energies are directed to the tribal, rather than the individual welfare, and the latter is in a degree sacrificed to the general good—the germ, in fact, of what we now call patriotism. What advantage to the tribe these changes involve hardly needs stating. Complete subordination to a directing head, like the rapidly co-ordinated muscular actions of a fighting animal, is an absolute necessity to the war-like success of a co-operating group of men. And the willingness of each individual to value the general triumph above his own safety, is no less important to the same end. Out of these two earliest structural adaptations there have grown, in the course of social evolution, a vast complexity of others based upon them, and tending to the successful performance of the same great function—the prosecution of war.

For the elaboration of this truth we refer all who may be skeptical to Herbert Spencer's discussion of the "Militant Type of Society." It suffices for our purpose to point out that this "militant type" is the one in which social organization begins.

In pursuing the ends of early militancy, the active brain of man struck upon a course which has forever lifted him above all other living things, the use and adaptation of external forces for the furtherance of human ends. With the first weapon fashioned by some prehistoric warrior was opened a new field for the exercise of human energy. Work for the purpose of creating was initialed in contrast to the destructive activities of the animal world. Step by step expanding intelligence led the labor of brain and hand first to producing appliances for war, the prosecution of which against both man and beast was necessary to the support of life, and then to supporting life directly by the creation from natural sources of its requirements. To manufacture for man's wants out of Nature's resources began to take the place of a mere sanguinary struggle over her raw materials.

Labor became a partial substitute for fighting.

It needs no demonstration that this new use of the energies had nothing in common with the earlier animal instincts from which the militant social structure evolved. What, then, could

be more natural than to find that, with its growth, a structural readaptation of the social organism has been taking place? Such a readaptation has been, and is, in constant progress; and the great authority, to whom we have above referred, traces out, under the title "Industrial Type of Society," the character and tendencies of the structures it is producing.

Thus, starting with the dictum of modern sociology that society is an organism living by constant adaptation to surrounding conditions, we find that its earliest structure is the "militant," fitting it for the predatory life of war; and that a new structure, suited to living by the fruits of productive labor, is being constantly developed by it. Let us briefly contrast these two social structures as they appear in our highly evolved life of to-day.

"Militancy," as is shown in its early development of a chief or tribal leader, entails, above all, autocratic government. A nation, to fight well, must act under one centralized control. It necessitates, furthermore, the existence of the individual for the benefit of the state; as, the more complete the subordination of the part to the whole becomes, the more will the combined energies be concentrated for national ends, and freed from waste in the direction of mere personal requirements. In its completeness, "militancy" means the absolute monarch ruling unquestioning subjects; the development of tyranny in the superior, slavishness in the subordinate, and all those harder and more savage traits which are best suited to the needs of war. It means the worship of might, and the creation of rigid social classes based upon it, such as survive even to-day in the aristocracies of civilized Europe. If "militancy" could be complete in its sway, the word "freedom" would not exist in language, for freedom denotes the assertion of individuality, and "militancy" the merging of all individualities save those of rulers. In a word, society under unqualified "militancy" is very naturally best typified by an army and the system which governs it.

What under this *régime* would be meant by the word prosperity? When is a militant society prosperous? Obviously, when the end for the achievement of which its structure has been evolved is completely attained; or, to specify, when the maintenance of the lives of its component individuals has been assured by the forcible destruction of competitors, and the acquisition by capture of all coveted fruits of the earth.

To illustrate by an example: Rome was a community in which the militant organization immensely predominated, and whose unchallenged mastery of the ancient world justifies, as applied to her condition, the word prosperous. This prosperity was achieved through the gradual acquisition, by force of arms, of nearly all the territory of the known world; through an en-

slavement and absorption of rival communities analogous to the assimilation of food by an animal organism; and, in fine, through a literal devouring of all the social organisms in her environment, which lasted until, like a great parent-cell, she burst into the many smaller cells that constitute the nations of modern Europe.

Turning to "industrialism," as its distinctive features are beginning to show themselves in our modern civilization, we find tendencies almost directly opposite. To begin with, the effort to sustain life by productive labor requires, for its success, that the best energies of each individual should be concentrated on the particular work his capabilities fit him for, and taxed as little as possible by the requirements of society as a whole. Every man must be left to develop himself to the utmost, as the total product of the labor of all can only increase with the efficiency of each. This necessity is soon rendered still more imperative by that early differentiation in industrial organization which localizes the production of different forms of commodities, and leads to barter; for only in the absence of the capricious meddling of authority can producers of one commodity measure the permanent value of their work in relation to the products of others. Furthermore, that a strong enough motive for the greatest individual exertions may ever exist, the returns of labor must be proportioned to energy expended; and this they never can be when the natural working of cause and effect is set aside by the artificial action of government. The outcome of these facts is the assertion of freedom; the belief, exactly opposed to that of "militancy," that the state exists for the benefit of the individual, and the consequent tending toward popular government.

"Militancy," then, sacrifices the individual to state-preservation. "Industrialism" uses the state as a means to individual betterment. Growing "militancy" produces concentration and increase of governmental power; restriction of the larger human sympathies involved by national enmities; rigidity of class distinctions, and subordination to authority. With growing "industrialism" the sphere of governmental control diminishes; its hold upon individual freedom is relaxed; the common brotherhood of man grows with the intermingling of commercial life, and the class distinctions built up by brute force melt away in the competition of productive energy. The community lives by the separate activities of its units carried on for personal ends, and unimpeded by the unnecessary meddling of central authority. That prosperity under this *régime*, in its completeness, differs from the prosperity of "militancy," above defined, as daylight from darkness, a moment's contemplation of it will show.

In order to insure it, the aggregated toil of the earth's inhabitants would be left to produce from the soil all the needs of human life. Unhampered by artificial restrictions, and untaxed by waste or destruction, the wealth so produced would more than suffice for this end. Its distribution, left to the natural laws of competition and of supply and demand, would be such that the greatest energy and skill expended would bring the greatest returns; and men would obtain of the world's goods according to their deserts. The prosperity of "industrialism" in its perfection would be but another name for the millennium, when all men would toil in common brotherhood, and each take from the store of wealth produced the equivalent of the work he contributed.

A wide and all-pervading difference thus exists between these types of structure into which the social organism tends to grow, showing itself especially in the utterly unlike conditions each requires to realize prosperity. That they are at variance, and must strive to displace each other wherever they coexist, is too obvious a corollary to need verification. How this fact points to a true conception of the philosophy of commercial depression, let us now see.

A universal law of social progress, with which we are all familiar, is that established systems in thought, morals, manners, government, or any department of human activity, struggle to perpetuate themselves by a fight against all innovations. Whatever is new and progressive, or represents the requirements of an enlarging field of life, has got to gain its foothold in the face of the powerful opposition of the old and pre-established. Those more perfected and exact conceptions of Nature, which we call scientific ideas, have prevailed only after centuries of mortal strife with the inherited superstitions and imperfect generalizations of our semi-civilized forefathers. The progressive and liberal governments of our most advanced nations to-day have been established in spite of the bitter opposition of their predecessors, and are themselves fighting tooth and nail the higher forms that will succeed them. In literature and art old schools strive to deny existence to the new; and, even in the little affairs of our daily lives, we are all permitting the things that are, and "have sufficed to our fathers before us," to keep out the better things that might be.

The result of this universal war between the old forms and the new is, to the former, ultimate change or destruction; while to the latter—and here is the vital point of what we are trying to demonstrate—it is constant *retardation*.

Every triumph of superstitious ignorance *retards* the harmonious spread of science; every point gained by the political

conservative is a set-back and a hindrance to the attainment of the liberal's greatest ends; and so on, throughout human affairs, is there a check—beneficial in its regulative influence, but still a check—to progress.

Now, what are these substitutions of science, in our knowledge of men and things, for a relative ignorance? Of the newer and better for the old and worn-out in political institutions? Of the new art and literature of broader life for that which stood for simpler feelings and ideas? Of the future of all things human for their past? They are simply the details of the one all-including change by which the social organism is passing from "militancy" into "industrialism." That change in which the life of destructive violence, inherited from the brute creation, is giving place to the life of productive labor we call civilization. And, if what is true of these details is true, as it must be, of their collective sum, then the evolution of "industrialism" is constantly suffering *retardation* from the persistence of established "militancy."

This is the generalization at which we aimed. Commercial depression is due to the retardation of industrial growth produced by the survival of militant organization.

There is but one test for the validity of all theories, and that is their application to the facts of which they treat. To fulfill this test in the case before us, let us turn our attention to Europe, whence the cry of commercial depression has for some years been exceptionally acute.

We find there an armed camp of nations in constant readiness for war; the fruits of the tireless labors of the people drawn off for the nourishment and support of ever-increasing military organization, so that every year turns what should be the reward of growing wealth into accumulating public debt; militancy in the prepondering forms of government; militancy in international relations, successful militancy the ruling ambition at the sacrifice of all industrial aims! But, bear in mind, it is no longer militancy in its prime—like that of Macedonia or Rome. It is modern militancy, riddled through and rotted at the core by civilization. Not one of the great nations, wasting its substance in the costly armament of war, can ever get a return on the fatal investment. The day for enslaving neighboring states and living on the fruits of battle is past. Every costly struggle of the century has left the combatants poorer and retarded their growth. Where are the fruits, to the prosperity of France, of Napoleon's fabulous conquests? to England, of the Crimean war? to Germany, of the war of 1870? to Russia, of her struggle with the Turk? Not one of the parties to these wars has fattened on the spoils of the enemy, and all have been joint losers

in the wealth destroyed. How clear, then, is the source of commercial distress! The machinery of war, which can no longer be made profitable, exhausts, in its unnecessary perpetuation, what ought to be the surplus of production. It has become a system of disbursements without counterbalancing receipts, producing scarcity and want.

With what state of facts could our theory more exactly correspond? Is not the condition one where surviving "militancy" is impeding that "industrial" growth in which alone civilized prosperity can be found? Then the only remedy for European poverty and distress is plain. The disappearance of autocratic governments, the disbandment of armies, the repeal of artificial restrictions on trade imposed to raise the revenues of war; in a word, the removal of all that has its roots in "militancy." Slowly, indeed, will this great, far-reaching change come about, but with it alone can the growth of what we call prosperity proceed.

Leaving warlike Europe, and turning home to our own great, peaceful, and hard-working commonwealth, it would seem that "industrialism" being so manifestly the type of American civilization, the existence of commercial depression with us affords evidences fatal to the theory we have been elaborating. How, if this theory be sound, can a land of peace and free government ever be the scene of "hard times"?

First, as a partial substantiation of our position, we would point to the familiar fact that the accompaniment of the predominating "industrialism" of the United States has been a growth of wealth and prosperity far exceeding in rapidity that of any other historic people. All that remains for us to show, therefore, is that the interruptions to this prosperity are to be traced to militant tendencies.

There are two great issues before the American people to-day, in the settlement of which, all are agreed, the national welfare is deeply involved. These are the tariff and the currency issues. Let us inquire into their nature. Institutions, like men, may largely be judged by their genealogy; so let us ask whence came this system of enormous taxes upon imports, the wisdom of which men view so differently. We find it had its birth in the necessities of war. True, the representatives of a number of wealthy industries, which have fattened at the public expense under this artificial barrier to competition, would have us believe that the function of a tariff is to start a nation into industrial activity —the extraordinary implication being that industrial activity would not arise independently of such a device; but of the almost impassable barrier, which confines our commerce to-day, war alone was the creator. To the philosophic observer, then,

the tariff can yield but one interpretation: It is a militant appliance for raising money, which has been continued in existence after militant necessities have ceased; and our surplus revenue, drained from the labors of the people and poured into a treasury that has no outlet for it, fitly symbolized its uselessness and waste.

But how about the belief, ever rising to the surface of our political whirlpool, which, in its extreme shape, advocates printed pieces of paper as a medium of exchange; and to-day, in a modified form, urges the use of a silver coin of less than its pretended value? Was it in the slow experience of peaceful commerce that men first detected the supposed benefits of fictitious money? Did the developing needs of industrial life lead to its use? No. Again war was the parent. War, destroying more wealth than the savings of a community could be drawn upon to supply, mortgaged the future with a promissory note; and the mental weakness of many men, which incapacitates them from perceiving the necessary equivalence between a cause and its ultimate effect—from knowing that, in some form or other, every debt incurred must ultimately be met—deludes them into the belief that this note can pass current forever.

Twenty-seven years ago a reversion to militancy was forced upon us by our cruel civil war, which, like a disease, left its deadly taint in the body politic to linger on until to-day. In spite of the enormous growth that our vast territory, our active and laborious population, and the never-ceasing stream of immigration have rendered possible; in spite of conditions for wealth and plenty such as no people ever knew before—through the major part of these twenty years has been felt the influence of some vague deterrent to the completeness of prosperity, and the complaint of trade depression has been almost constant throughout the land. Militant forms, surviving in the tariff and dishonest money, will in time be recognized as the efficient causes of this state of things.

If what we have said stands for a real truth; and if the general underlying cause of all commercial reactions is to be found in the protracted life of a system that society has outgrown, which checks the growth of one more suited to its needs—the realization of the fact can not fail to be of value. All legislation, based on such knowledge, would proceed in the line of real commercial advantage; and a test by which to judge the fitness of new measures for the needs of modern life would be supplied. Lest this should seem too visionary, we shall close with an illustration of its possibilities.

The community to-day is deeply moved by a new disorder of the social organism known as the "labor problem." The lower

classes, or those who are more distinctly physical as opposed to mental laborers, are striving to offset the corruption and abuses of the very wealthy by a system of organized aggressive action. They have accomplished nothing, so far, but harm to themselves, and diffused disturbance to the great mechanism of trade through which the entire people live. The generalization we have tried to establish furnishes the key to this difficulty.

The interest of the "laboring class" so called, as well as of the whole community in America, is purely industrial. The laborers are the product and symbol of industrial growth. No good, therefore, can be worked for them save through industrial appliances. Now, if we inquire into the character of the organization known as the "Knights of Labor," we find it to be as purely militant as the name it bears. It displays absolute autocracy of government; complete loss of individual freedom; the gospel of class hatred and strife preached in the place of the cooperation and sympathy of "industrialism"; and, finally, the natural outcome of all militant tendencies, a resort to physical violence for the attainment of ends. The "Knights of Labor" are a militant organization applying militant means to the betterment of industrial conditions. What wonder that they fail?

And, withal, the industrial means to the attainment of all legitimate ends that they may seek are ever at their disposal. What abuses could the rich few perpetuate in free America, if the poor many chose to use the ballot-box to crush them out? None. And if, as appears to be the case, it is a grievance that the able and hard-working triumph over the foolish and lazy in the struggle of life, the reconstitution of man, not of society, will alone remedy it. Is there not here a hint for Messrs. Powderly and George?

In an essay on "The Swarming of Men," Mr. Edward Courtney assumes that emigration is controlled by a force which operates as strongly and uniformly as any natural law. By it, whenever men find it too hard to make a living, they are induced to move themselves away, either to places within their own country where work is more plentiful, or to places beyond the sea. "An examination of true centers of life," he says, "leads us inevitably to connect the shifting points of maximum increase with the development of some industry, the discovery of some local springs of activity, a new appreciation of previously unrecognized facilities for the application of more efficient processes of labor. Some change makes it possible for more life to be sustained at a given spot, or to be more favorably sustained than elsewhere, and immediately more life appears there."

WHISTLES ANCIENT AND MODERN.

By M. L. GUTODE.

NO instrument, probably, has been invested with more various forms than the whistle. It would take a volume to present properly all of these forms and their passages from one to another, which I have no intention of doing. I aim only to distinguish a few points that may indicate to others how extensive a field there is into which they may explore if they will. The primary idea of a whistle lies in the making of a column of air to vibrate, in whatever condition. As there is no lack of means or methods for doing this, the infinite diversity of the forms of the apparatus for producing the vibrations and the resultant sounds is a matter of course. The most general form is the human whistle, which one can make sound—after a fashion—without much preliminary training; but many musicians have made themselves masters of its intonations to such a degree that, instead of the usual inharmonious and unmethodical discords, they can render with it the most difficult passages of elaborate musical compositions. I shall not dwell upon the means that may be employed to make the sounds sharper and to modulate their tones. Every one knows what effects are produced by inserting the fore and second fingers so as to turn the tongue slightly back as the column of air passes over it, or by sending the blast over the outside of the bent fingers.

If we seek other primitive whistles, we have them in the hollow-barreled key, the terror of authors and comedians; the famous willow whistle, cut when the twig is most sappy; the green dandelion stem, split along its length; the nut-shell between the fingers; the cherry-stone, which school-boys grind down so patiently on the soles of their shoes and perforate; the buck-horn, and all the other things which we are fond of contriving, in our early youth, with which to split the ears of parents and teachers.

Seeing that so much can be done with such rude means, it is not strange that the whistle was a well-known instrument in antiquity. The old Peruvians were past masters in the fabrication of whistles. They made them in great numbers, of earth, and ornamented with various designs and figures of animals. The porcelain-factory at Sèvres (Fig. 1) possesses two specimens of their workmanship, one of which resembles a nightingale; and, when filled with water, it produces a kind of warbling. There is an instrumental museum at the Paris Conservatory of Music, which is open to the public on Thursday afternoons. It was

founded by Clapisson, and in the beginning consisted only of a single collection—of whistles. This was, moreover, a most curious collection, comprising whistles of all ages and all countries, of terra-cotta, copper, ivory, hard stone, etc., some of which were

FIG. 1.—ANCIENT PERUVIAN EARTHEN WHISTLES. Nos. 1 and 2, figure of an animal, in face and in profile. No. 3, another form. (From specimens in the Sèvres Museum.)

remarkable as specimens of invention and workmanship. Unfortunately, this collection was scattered to the winds at an auction-sale twenty years ago, and the conservatory has not preserved any part of it; but there are still a great many curiosities in the instrumental museum—serpents in the most distressing shapes,

horns and trumpets of crystal, flutes of porcelain, fiddles of faience, Alpine horns, a bassoon of such extraordinary adjustment that it is a day's work to dismount it; and many other most curious contrivances for producing melodies and accompaniments.

One of the most simple whistles, most closely approaching the theoretical form, is the American, or secret whistle (Fig. 2), which is composed of a strip of metal bent over, one end of which, A, is cut beveled, and is placed opposite the opening of the hollow box *o o'*. Apply the mouth and blow at *o*—no sound is produced; and in this lies the secret of the instrument. But on closing the open ring T with the thumb and forefinger, a vigorous whistling sound is obtained, the intensity of which may be modified by raising or lowering the bevel, A, so as to bring it nearer to or farther away from the box *o o'*.

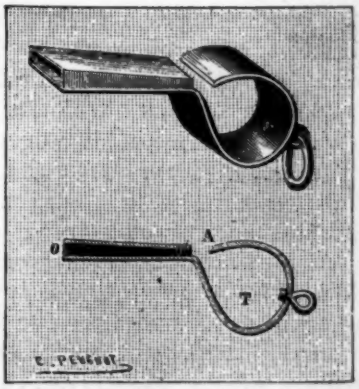

FIG. 2.—SECRET WHISTLE. OUTER VIEW AND SECTION.

A pen and pencil-case whistle, with which dealers in holiday toys have had considerable success, deserves to be mentioned here. It is an ordinary whistle at the end of a tube, in which a solid cylinder is moved so as to modify at the will of the performer the length of the column of vibrating air. Persons skilled in using it are able to play a considerable variety of simple tunes upon it. Among the whistles that give out several notes, we

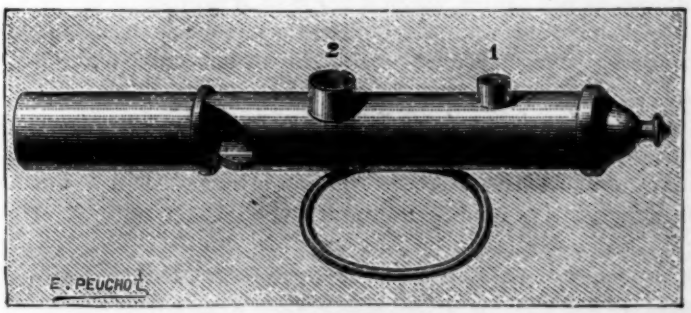

FIG. 3.—COMMANDANT'S WHISTLE.

also cite the commandant's whistle (Fig. 3), which, besides its mouth, has two openings that are controlled by the fore and middle fingers. With both holes closed, it gives the note *sol;* with hole No. 1 open, *do;* and with both holes open, *mi*.

We might make a distinct and legitimate study of numerous forms of sounding apparatus, constructed on the theory of the whistle, whose peculiarities consist in the manner in which the air is sent over the tongue, the vibration of which produces the sound. Thus, we have the pedal-horn, and the India-rubber bulb whistle of tramways and omnibuses, the various systems of horns that give notice of the approach of fire-engines, the alarm whistles of steam-engines, "howler" whistles, and locomotive whistles; the last of which are sometimes tuned to nearly a distinct tone for each line. Much that is interesting might also be said concerning the variations in the engineer's whistle for his different calls, upon the signal-man, for the clearance of the track, etc. But this would take us away from our topic.

Modern common whistles are infinite in their variety, and new kinds are appearing every day, as the fancies of amateurs bring them forth. They are made of wood, bark, metal, horn, shell, glass, and even of sugar. While the form of the apparatus and the manner of using it change from time to time, as the fruitful imaginations of fanciers devise new patterns, the principle of the construction is invariable. Some conception of the capabilities in design of the instrument may be gained from a glance at Fig. 4. Among the whistles here represented, we find the scholar whistle (3), the fireman's whistle (5), which gives *mi* when the upper hole is open, and *do* when it is closed with the finger; the Belgian whistle (15), of inelegant shape; the square whistle with two holes, giving two notes (7); and the Baduel army regulation whistle (9). Of a quite different type is the Swiss whistle for railroad-station agents (2), in which the column of air is broken upon the summit sphere and a part is swallowed up, while another part is thrown outside. The marine regulation whistle (6) is of a similar structure; but, like the American whistle, there is a secret in manipulating it. In order to produce a sound, the upper end of the pipe and the adjacent sphere must be shut up in the hand. A variety of movements are necessary for the execution of different modulations, which make a whistling-school on the quarter-deck the analogue of the schools of the trumpet and the drum in regiments. There are also whistles with three or four openings, like the horn whistle and the railroad whistle. In the former (12) the extremities A and D may be regarded as mouths, and the sounds are also modified by closing alternately or in succession the openings B and C. In the second (13), by leaving all open, we obtain a quite characteristic mixed and false sound. Special modifications are obtained with the roulette whistle (1) and the bird whistle, with which the songs of various birds are imitated. Fancy has run rife in devising typical whistles, like

the dog's-head whistle (10) for hunters, and many-ended whistles, like the army whistle with compass (11), the match-box whistle

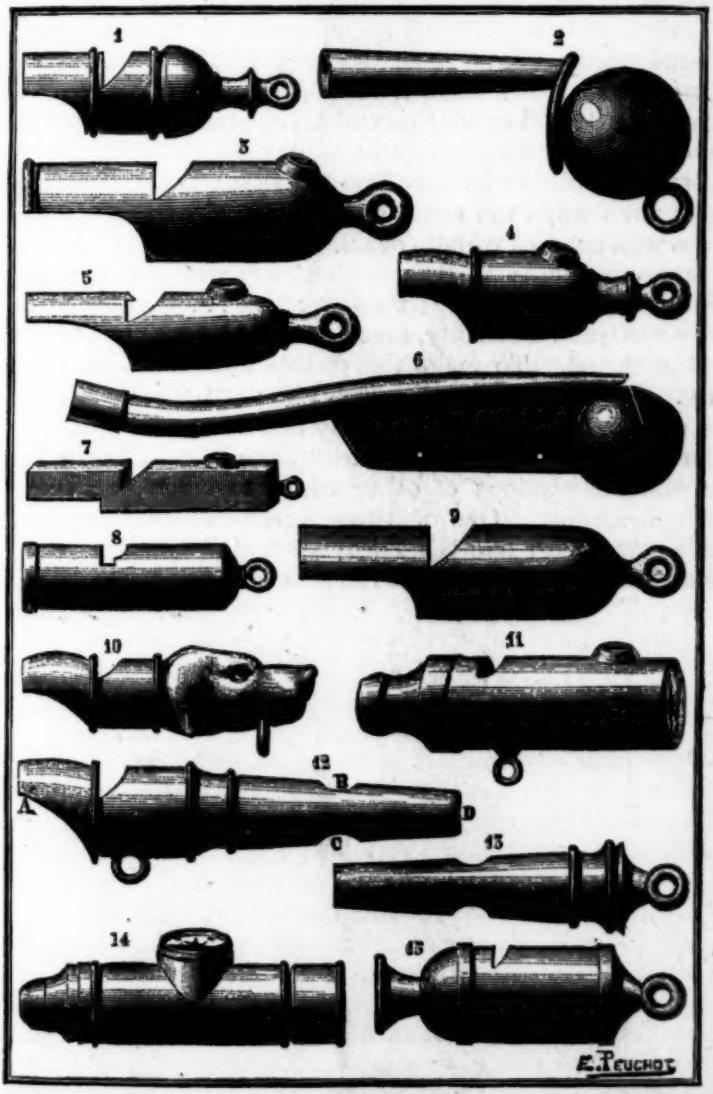

FIG. 4.—DIFFERENT KINDS OF WHISTLES. 1. Roulette whistle. 2. Swiss railroad-station agent's whistle. 3. Scholar whistle. 4. Another type of the same. 5. Fireman's whistle. 6. Marine regulation whistle. 7. Square whistle with two holes. 8. Round whistle. 9. Army regulation whistle. 10. Dog's-head whistle. 11. Army compass whistle. 12. Whistle and horn of three notes. 13. Railroad whistle. 14. Match-box and compass whistle. 15. Belgian whistle.

(14), cigarette-case whistles, whistling canes, whistling hunting-whips, whistling sleeve-buttons, etc.

Among the matters to be taken into account in the making of whistles are the effect of the length and the diameter of the

tube, the width of the mouth-piece and its length, the size and thickness of the tongue, the diameter of the instrument, the size of the orifice, the nature of the material of which it is composed, etc., variations in any of which produce—sometimes very important—modulations in its tone. Experiments have shown that *do* and *mi* in particular have a round, full, well-supported sound, which in the Baduel regulation whistle can be heard for a distance of more than six hundred metres.

Competent observers have asserted that the manner of whistling is not always the same, and that there are some unhappy persons who can not whistle at all. According to these authorities, among whom is M. Baduel, to whistle well it is necessary to pronounce *tu . . . tu* slowly; then *tu . . . tu . . . tu* more and more rapidly and quite distinctly, especially taking care not to whistle from the throat. To make the double tongue-stroke, we must say *tu . . . du . . . g, du,* to give the trill; but we should always begin slowly, and proceed gradually to greater rapidity.

Correspondents of "La Nature" have sent in to it illustrations and descriptions of other whistles than those which M. Gutode describes. One of them is a terra-cotta bird-shaped whistle, somewhat like the Peruvian whistles, which has been recovered from the prehistoric relics near Florence (Fig. 5). The

FIG. 5.—EARTHEN WHISTLE FROM NEAR FLORENCE.

sound is produced by blowing into the bird's beak. Another, an extremely simple form, is used by the foremen in the spinneries of northern Europe, to direct the changing of the bobbins on the looms. It is made of tin (Fig. 6), and gives out a sound

strong enough to overcome all the other noises in the shop, while it is also susceptible of musical modulations. But there is a special art in sounding it. The tongue must be brought up to the hole in the upper blade without stopping it, and the air must be projected simultaneously through both holes, so as to

FIG. 6.—SPINNER'S WHISTLE.

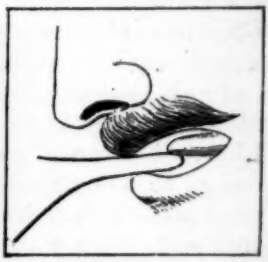

FIG. 7.—HOW THE SPINNER'S WHISTLE IS USED.

vibrate in the bent-over part (Fig. 7). After a few efforts, sounds of astonishing power can be produced on this instrument.

Every boy knows how to make a willow whistle; or he may use lilac or any of several other woods when in the sap. Taking a branch about the size of his little finger, he cuts a ring in the bark down to the wood. Then, having moistened the bark in his

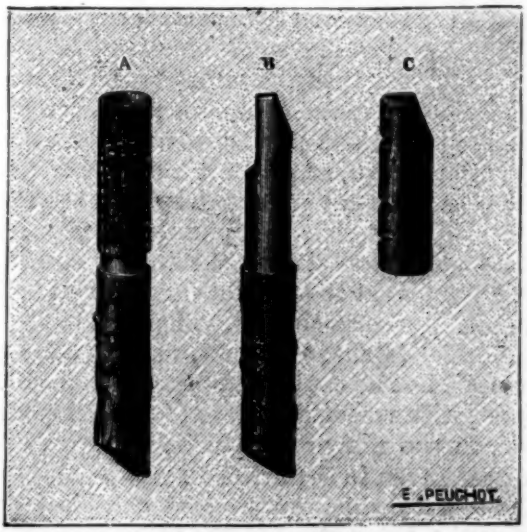

FIG. 8.—WOODEN WHISTLE.

mouth, he beats it, holding it on his knee, with the handle of his knife, till it will slide on the stick. Holding the lower part of the branch in his left hand, with his right hand he twists the loosened slip of bark and pulls it off in a single piece, forming a

hollow cylinder, perhaps an inch long. He then slips the ring back over the stick as in A (Fig. 8), or he may trim the stick and cylinder as in B or C, previous to readjusting them, to form the shape almost universally in use.

Among the latest devices in the way of whistles are the curious chemical toys made with picrate of potash. When the whistling rockets and fire-pieces first appeared, the whistling was commonly supposed to be produced in the same way as in ordinary whistles, by the air-movements produced by their rapid motion. This is, however, not so. The operation is not at all like that of an air-whistle, but the production of the sound is owing to the peculiar property of picrate of potash of whistling when it is burned. This effect is heard very clearly with that salt when compressed in a tube, and the sonority may be augmented by the addition of various substances. Such a composition may be formed, with no other danger than usually attends the manipulation of explosives, by triturating a mixture of fifteen parts of picrate of potash and one part of Judæan bitumen. It is then charged into a pasteboard tube a little less than a half-inch in its interior diameter, and some two and a half inches long (Fig. 9). The tube is closed at one end by a plug of closely tamped clay. The composition is introduced in small charges evenly compressed, till the tube is filled to within about three quarters of an inch of the open end. The whistle may be wired upon the cartridge of a rocket, when it should be furnished with a cap penetrated by a quick match, which, entering the picrated composition, is also inserted into the throat of the rocket, so that the two fire-works shall be inflamed at the same time. The sound of these whistles is sharp at first, and passes gradually, as the tube is emptied of its contents, to a grave tone. By combining the whistles with various devices of fire-works, curious effects are produced, in accordance with which expressive descriptive names have been given to the artifices.

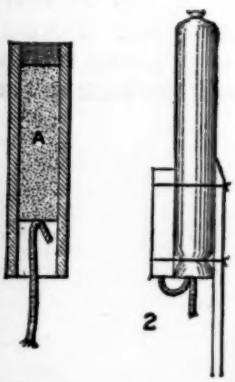

FIG. 9.—PICRATE OF POTASH WHISTLE. *a*, the whistling composition; *b*, rocket with whistle attached.

When the picrate whistles were first exhibited at Havre, on the occasion of the *Fête nationale*, the spectators, irritated at the strident noise they made, and mistaking its origin, exclaimed: "Down with the whistling fellows! duck them!" The enjoyment of the festival was much enhanced when the joke was explained.—*Translated for the Popular Science Monthly from La Nature.*

THE EARNED DECREASE *VS.* THE UNEARNED INCREMENT.

By JOEL BENTON.

READERS of Henry George's empiric philosophy have been told—and his acolytes peddle out the platitude with much phrasing and infinite iteration—that society is greatly wronged by something which he calls an "unearned increment." This unearned increment is a thing which all property, personal as well as real (if you except cash in hand and some of its exchange equivalents), is subject to. It may heap itself just as vigorously upon a dozen eggs or a bucket of soap as it does upon a piece of land. The increment arises, too, from some want or movement of society. But this habit which property has doesn't trouble these millennium-makers and poverty-extinguishers. It is only a subject for complaint, in their view, when it touches a piece of land.

The stock sample of the injustice they inveigh against is the rise in value of a town lot. In fact, you can not get the mind of a Georgeite off from a town lot. He pitches his tent there; and if, for any reason, he strays briefly away, when you are not talking to him, to the open country, a word of opposition to his whim will send him back flying to that magic foothold. One would suppose, if the fury with which he thrashes the air were really evidence, that nobody ever bought a town lot or a plot near a city who did not at once ride into a fortune by its buoyancy, or else reap a happy sum which, in equity, belongs not to him, but to everybody collectively. But the whole doctrine of Georgeism is a strange perversion of, not only political economy, but of the exact truth of the matter in hand. The history of land-ownership of all kinds everywhere is as strikingly a history of losses as it is of profits. We see the successes, as we see the ships which float on the ocean, while the unnumbered wrecks in both cases are out of thought and beyond vision.

At one time in the history of St. Paul, Minn.—to make one instance stand for a multitude—only two or three men could comfortably hold their real-estate purchases. All the rest who had investments were not only glad to give away the hope of increment, but were willing to give up all, and often more than they gave to purchase their holdings, to be freed from the debt on them. In fact, a universal bankruptcy and panic prevailed among all who owned land. It is not an uncommon circumstance to find, too, that those who buy city realty, and hold it any length of time, although the increment may seem very large, have paid

for this increment entirely through taxes, interest, and improvements. I am not sure that the man who said he had seen the time when he could buy all the ground Chicago stands on for a pair of boots, and only hesitated to do so because he lacked the boots, would have made such a wonderful bargain as might be supposed, provided he had had to pay for everything necessary in order to hold it, and had held it up to date.

But suppose, in Chicago's case, there would have been a profitable purchase for him who thought he saw the opportunity. His capital embarked, his possible risk, his care and time, would entitle him to the outcome. But what shall be said of a town not a hundred miles away from Chicago, which was laid out on the same lake with equal expectations, whose broad, houseless avenues now are—as for thirty years they have been—a silent comment on something quite different from the so-called "unearned increment"? And what of other similar would-be cities—frogs that, like Æsop's, burst themselves irretrievably, or those who took stock in them, in trying to attain the ox's magnitude? The situation in reference to disaster with the city lot is full as appalling—if foresight and gain are appalling—as it is in the direction of profit. If society has a claim upon this profit in the socialistic way which George and his followers claim it has, then, to make the equities right and even, it ought to shoulder, without a whimper, the losses which have befallen the land-owners who have suffered from the "earned decrease."

Probably, if we go outside of a few large towns (the area of all towns being an insignificant part of the planet), it will be found that what I call the "earned decrease" is a more surprising factor in the history of land than any other fact connected with it. Just now there is no farming in this country to speak of east of a line drawn as the Alleghany Mountains run, and very little east of the Mississippi River, that is really comparable in its profits with the profits of almost any other business that is good from skillful management. The farmer himself is a toiler who has—with a day's labor at least from twelve to thirteen hours long—constant obstacles against his rise, and the majority of farmers in the older States are little better off to-day than when they began their business twenty, thirty, or more years ago, provided they began without capital already earned. Who does not know, too, that the owner of land works harder than any man he employs?—frequently with less success, and always with an amount of harassing anxiety that the hired man rarely experiences, and can not, in fact, possibly experience in kind.

One only needs to make a study of the farms, as they stand all through the country, to discover that it will need a more powerful catholicon than *access to land* to cure all our social ills. Nor

is there any way to apply this remedy if it were an effectual one.

Again—to refer to the farmer once more—the land of a farm well tilled is not only now thoroughly mixed with the farmer's toil and skill in the improvement of its constituents, but it is covered with buildings, fences, ditches for drainage, and wells, that represent his hard-earned labor or his free capital applied to it. Can he get its whole value back when his estate is settled, or if he wishes to retire or remove? Very rarely—almost never, in fact. Other business plants that have been well handled usually sell out at a profit, more or less. But the farm goes off at the sacrifice of an "earned decrease." Two farms within a half-day's ride of the place where I am writing, in one of the best soiled and best settled counties in the State of New York, have lately been sold (not under legal constraint) for *less than half* what they and their improvements originally cost, involving losses respectively of from eight to ten thousand dollars. And this is not a strange or infrequent thing. It, or something like it, is one of the commonest of modern occurrences. But do we hear any school of philosophers agitated about these losses? Society, in some way, has unbuilt or leveled their value by just as responsible doings as it has by worthy and rewardable doings built up the city lot.

If it is to have the fat meat in its pudding, on what principle can it free itself from responsibility for the lean? Can society or the state play at seesaw with the owners of land? Can it say, "Heads I win and tails you lose," and ever undertake hereafter to talk about right and virtue and honesty? If it should ever hanker after the "unearned increment," there should go with it when it is passed over an accounting for the "earned decrease."

That this is not a small matter, a reference to the New England "hill-farms," so called, will amply show. In hundreds of towns there, from which the population has withdrawn itself to aggrandize certain factory towns, or to develop the West, the whole farming area has met with an irremediable loss. Farms can be bought for far less there than their surface improvements alone cost. A friend of mine bought a productive farm of one hundred and sixty acres in Massachusetts a few years ago, with a good house, barn, and other fixtures upon it—and he did not pay *the price that the barn alone cost!* Purchases of farms at a similar advantage can be made to any extent in New England, not far from pleasant country villages and near railroads, and there is no place in Massachusetts that is over twelve miles from a railroad. This means getting the land itself for *less than nothing*, which is on better terms than Henry George's creed calls for. In addition to his land, my friend had the house and fences, and some other things, thrown in. And yet the millennium

is a good deal further away from those farms than good society and the railroads are. But, according to the doctrine of those who are afflicted with George's peculiar land-fetichism, it should be already there.

It is probably true that Western farming is a better business than that which prevails in the East; but an anecdote is told of that which, if not literally true, is illustratively so for many who are engaged in farming. It does not, at any rate, overstate the gravity of the task which many persons assume who undertake to own the soil that George would sequester to the state. And this is the anecdote: A farmer in the West, who kept his business going until he nearly became bankrupt, was obliged finally to sell his farm to his chief creditor, who happened to be his faithful hired man. After a term of years the new owner found himself hopelessly in debt, and he proposed selling out to *his* hired man, who happened to be the previous owner, and who by this time was able to buy back his old farm! Whether this process of exchange continued to go on like that syllogism of Epimenides the Cretan, with no conclusion, I can not say. But when anything like it can happen once, how is a mere divisional share in the soil to mend or make over the world?

To return for a moment to the "unearned increment," the question one would like to ask is, why an increment on the value of land is any more wicked than it is upon a ton of coal or iron taken from the land? The title to a house or chair made of wood can not be good if the soil which produced the wood is held by spoliation. That which vitiates or annuls in one instance must in the others. The increment-reasoning, too, if it proves anything, proves too much. Is nothing earned in this world but mere wages? Is nothing due to foresight or perceiving what is likely to happen? Must profit all be resolved into day-wages from muscular effort solely? Are mind and thought and skill not to be considered factors which a man may use in the struggle for existence? Is the inventor, who is usually a poor toiler, to have no benefit from his wits? The sect of "labor" seems to say "No" to all these questions; and both it and the Georgeites, if they could have their way, would put us all on an express train toward barbarism and the Bedouin Arab, who is a George communist, and to the extinction of all that makes a civilized life possible.

The "unearned increment," it should be noted, is not a discovery of Henry George's. Mill and Spencer gave it a theoretical existence, but proposed no such drastic remedy for the ills supposed to flow from it as Henry George formulates and would apply. They saw that in London, where poverty is wide in extent and squalid in character beyond that of any other spot on

earth, the land on which people lived and moved rose to a fabulous value, the profit of which seemed to go to a few exclusively. The man who owns a lot in London sees it double and quadruple in value, and then double and quadruple in value again many times, not by any improvements he puts upon it, nor by any labor which he himself does, but simply by the increase of population about him, and the demands growing out of the multiplied business and wants which a population unparalleled in numbers creates. According to Mill and Spencer,* it is society, then, which makes this value of the land, and not the owner of the land. The increase which befalls it is not earned by him, but is the result of the growth of society. Why not, then, give back to society what society makes? In looking at England away from London, and at Scotland, the land problem is, in addition to this increment, made complicate by absurd laws of entail and transfer beyond anything which any other civilized country knows. Out of all this aggravation, a part of which can be reached by the modification of or the repeal of unjust laws, the "unearned increment" was suggested.

But neither Mill nor Spencer proposed to restore equality where they indicate inequalities by a wholesale system of spoliation on the innocent owners. They have not spoken of the wickedness of owning land by comparing it with the ownership of slaves, and in the same breath alleging that a full rental tax, a confiscation tax, indeed, will leave every man's ownership unimpaired. These are the absurdities which have been let loose in America only, where land can still be had for the asking, and where the appalling problem is for the man who owns land to compete—other things being equal—with the man who is not so unfortunate. It was said jocosely once, by a newspaper humorist, that a man living on a small, rocky farm in Maine, on an unfrequented road, felt visibly ashamed one day when a well-dressed traveler (as he stood in the front yard) passed his door and looked somewhat inquisitively at the dilapidated house and out-of-joint fences. As the traveler drew nearer, the supposed proprietor hastened to remark: "I am not so durned poor as ye think I be, neighbor; I don't own this 'ere land!" The joke is now too universal to be any longer humorous to the average land-owner.

Suppose we were to admit that some injustice exists in the irregular distribution of the rapid increase of land-values in large towns. The inequality is one which no legislation could

* After calling this spirit from the "vasty deep," both Mill and Spencer failed to lay it, or to suggest any means whereby it could be placated. Allodial ownership, whether rightful or wrongful in the beginning, was to them at this present moment a right and a fact too overwhelming to be whisked away by a mere breath of metaphysical analysis.

possibly remove without opening a door to immeasurable evil and wrong. Wealth itself is an inequality which renders possible the most lurid contrast in conditions of human happiness. To see the brown-stone front with a gilded carriage at the door, while a hovel with starving inmates is not many blocks away, suggests a train of thought as pathetic as anything the world has to show. But you can not abolish wealth without punishing economy and thrift, and taking away the incentive to rise in the world. You can only abolish it by abolishing civilization, to which wealth and poverty are incidents; and poverty you can not abolish, either while civilization lasts or after it is destroyed. Nothing was ever truer—as a declaration for the present, a description for the past, and a prophecy for the future—than the statement, "The poor you have always with you."

But schemes have been suggested for limiting wealth in one way and another, either by extinguishing the owner's power to bequeath it at all, or by reducing to a small allowance what may go to his children, or what he may bequeath; or by taxing each additional ten thousand dollars acquired above the first ten thousand at such a frightfully increasing ratio as to make the incentive to obtain money no longer attractive. This is a backhand way of trying to abolish poverty, or make it more tolerable by making everybody poor compulsorily. You can not do a more effective thing toward paralyzing energy and industry, and offering a bounty to laziness and unthrift, than to make the thrifty men of the world draw all the sloth and incompetence along. This is taxing them not only to support poverty, but to multiply it and make it prevail.

I have been comparing here the evils that seem to have relation to wealth with those which seem to some to grow out of the "unearned increment." But if it is a fact that a hovel of starving inmates can be seen not far from the palace of a man of wealth, is it not even a more closely related fact that the rise of the palace, and the man who lives in it, has directly helped thousands of honest toilers, and continues to help such, whether the man who is wealthy wishes to help them or not? But we do not notice, on account of this hovel, the thousands of well-to-do workers all over the land who have drawn tribute for years from this wealthy man's multiplied wants and luxuries, and who live plainly and comfortably from the fact that he and others like him live luxuriously. A society where wealth exists has evils, because evil is inevitable; but to cripple or destroy wealth would bring a deluge of disasters which no man, if he could foresee them fully, would be able to avert. I have been supposing what I do not believe, that the "unearned increment" involves some element of wrong. In continuing the supposition, I

must now emphatically remark that it really can not happen as a merely private benefit at all any more than wealth can happen as such. In a town of immensely rapid growth where this increment arises, the honest laborer and poor man who does not care to acquire land, or does not foresee the opportunity open to him, or can not command the means for doing it, still receives unparalleled opportunities in any pursuit he follows there. Wherever a so-called "unearned increment" arises, there society at large has reaped connected benefits which have been widely distributed. It would not be easy to set down how far this wave of advantage spreads; but we all know that it spreads very far, and that he is a very dull or a very shiftless man, who lives where it starts, who does not find some part of it beat over into his own cup, be it large or small. And the trouble which would arise from despoiling those who in a few instances have, by acquiring land, apparently obtained too easy a profit, would be the killing of the goose which had laid for the whole public the golden egg. It is more than probable that the "unearned increment" which has come to the land-owners in that Kansas town which has, in five years, jumped from a population of five thousand to nearly forty thousand, has gone in the largest measure to men who planned and made the progress seen there possible. In places where this is the case in a less degree, the effort to make things equal is a problem too great for any but angels and seraphs to deal with. No merely human device can touch it without breaking or deranging the mainspring of civilization. Yet there are plenty of fools who dare step in where angels fear to tread. The man who burned up his barn filled with grain to destroy a hornets' nest is not alone in the world. He now has a *cult* and a body of disciples.

Seeing, as all may, how little land does for its owner everywhere, and for an owner who has the utmost possible incentive that the strong motive of human selfishness supplies to enable him to succeed (which the state could not have), what possible hope can there be of any betterment of things by transferring all land to the state or to society collectively? Through what magic or enginery is it that the state is to conduct all its farms to a profit, and so rent city lots as to produce more benefits than now exist? No one not stricken with asinine idiocy can begin to tell.*

* It ought not to require any argument to see that every man who holds land to improve it, or who buys worthless land to make it valuable, is the friend and not the enemy of mankind. Private ownership of land, as it now exists, is largely a sacrifice for the public good. For it must be remembered that it is not direct *access to land* that is in the least degree necessary to any one individual, or to any one million of individuals. What *must* be had is simply access to the products of food, raiment, and shelter which land supplies. Now, if somebody else will do unprofitable soil-culture for my benefit, I will

How, too, is this needful transfer of land to the people to be made? This step is the *pons asinorum* which Mill and Spencer revolted from, and which George does not successfully cross. For the people to buy themselves out, would be the only honest way of transfer; but this would be like a man standing in a corn-basket and trying to lift himself by its handles over the fence. McGlynn, George's prophet and Hotspur, cuts the bridge down, and says all land must be taken, without compensation to the present "miscalled owners," and given directly to the state. It is not strange, with this crude conception of morals uppermost, that the new "crusaders" should not have a word to say of the "earned decrease." This whole scheme is all as shallow a piece of folly as the history of delusions will have to record. It will very properly take its place with "the moon-hoax," and with Captain Symmes's tubular theory of the earth, when the nine days' wonder of it, now waning, shall have collapsed.

THE EFFECTS OF MODERATE DRINKING.

By GEORGE HARLEY, M. D., F. R. S.

IT is because of there being at present such diverse views expressed regarding the influence moderate drinking has on the constitution, that I am tempted to contribute my mite of knowledge to the general stock, in the hope that what I relate may suggest new ideas in the minds of others who, like myself, are interested in the study of this intricate question. For I regret to find that, notwithstanding there has already been so much written, and well written, on the action of alcohol when taken in excess, no one appears as yet to have thought it worth his while fully to tackle the subject of moderate drinking. The reason of this, perhaps, is not far to seek, seeing that a little reflection reveals the fact that, although the majority of persons may truthfully be said to be moderate drinkers, and consequently medical men see far more patients belonging to this category than any other, they possess but very little opportunity of studying the effects of alcohol, when thus indulged in, upon the constitution, for the following reasons: 1. There

not stigmatize him as a robber; I will, on the contrary, exalt him as a public benefactor. Somebody has been lately computing the millions and hundreds of millions of mortgages which the farmers in our most thrifty agricultural States are now carrying. I will not name the sum total, except to say that its size is perfectly appalling. When I think of this, and the other facts dismally related to it, I feel like taking off my hat to every owner of the soil, and saying: "My good fellow, you have my supreme respect; for if you should ever be driven off, or abdicate, chaos and destruction would indeed come."

are not only no tables of statistics as to its effects in existence, but there are no means of acquiring them; the statistics of the effects of drunkenness, of which there are abundance of greater or lesser value, being unfortunately of no service whatever in solving the problem of the effects of moderate drinking either on mind or body. 2. In no instance are the effects sufficiently marked to necessitate any special form of treatment in a public institution. 3. The deleterious influences on the bodily functions are so insidious as in the early stages either totally to escape detection, or, what is more common, to lead them to be attributed to some entirely different cause. 4. The effects of moderate drinking manifest themselves in such a variety of different forms, that, even when their true nature is recognized, the general practitioner has not the opportunity of seeing a sufficient number of any one of them to admit of his drawing conclusions from them. 5. The men who have most experience of the severer forms of functional disease directly traceable to the effects of moderate drinking are, in general, merely those who, like myself, make liver and kidney diseases a special study; the liver, kidneys, heart, and brain being those organs of the body most affected by alcohol when indulged in within the limits of what is called moderation. Notwithstanding this fact, it being impossible for me, or even any one else specially engaged in the treatment of liver and kidney diseases, to collect a sufficiently large number of telling cases from which to deduce crucial data of the deleterious effects of small quantities of alcoholic stimulants habitually indulged in by temperate men, I purpose adopting the plan of drawing conclusions from the statistical data of the effects of alcohol on the human constitution when it is taken in the form of what is called "nipping"—that is to say, small quantities only being taken at a time, but frequently in the course of the day. Of these, fortunately, the registrar-general's reports of our national mortality in different industries furnish us with something approaching to reliable data. So I shall make use of them, along with some German statistics of a similar character, in illustrating the probable pathological effects of moderate drinking on the human constitution. For when one can not get what he wants, it is good policy to make use of what he has got, on the principle that half a loaf is better than none. 6. Added to all these drawbacks to the formulation of reliable conclusions regarding both the direct and indirect effects of alcoholic stimulants, taken in small quantities at a time, upon the vital functions, there is yet the other of reconciling different minds with what is exactly meant by the term "moderate drinking," seeing that a quantity which one would call moderate is not at all unlikely to be by another designated immoderate

drinking. Before attempting to define the intrinsic value of the two words, let me remind the reader that the mere use of the term "moderate," when applied to anything whatever—whether it be to walking exercise, or anything else—implies that it is merely a relative and consequently a fluctuating quantity, according to the capabilities of the individual and the circumstances of the case; for a moderate walk to a weak person is quite a different thing from a moderate walk to an athlete. So the term "moderate drinking," when applied to a girl in her teens, is something quite different from the term "moderate drinking" when applied to a robust man. Consequently its intrinsic value is not to be measured by quantity, but by the effects; and fortunately, as every thinking being is capable of doing this for himself, it is quite unnecessary for me to fix upon any given quantity, but merely to say that by moderate drinking I mean the indulging in alcoholic stimulants well within the margin of intoxication. I shall, for the present, confine my remarks on the effects of moderate drinking to those more particularly observed on the four important and indispensable organs of the body—namely, the liver, kidneys, heart, and brain.

Although all persons who indulge in alcoholic stimulants well within the margin of actual drunkenness speak of themselves as "moderate drinkers," there are two special classes of them which bear no resemblance to each other, except in the one solitary circumstance that they never at any time take sufficient to intoxicate themselves. The one class is that which only partakes of stimulants while eating; the other indulges in them between meal-times. To the latter habit is applied in this country the title of "nipping," while in the East it is spoken of as "pegging." And this is the most pernicious of all forms of drinking, from the fact that stimulants taken without at the same time partaking of food, though only imbibed in small quantities at a time, have most deleterious effects on the internal organs. A man who habitually indulges in a single glass of sherry in the forenoon, a brandy-and-soda in the afternoon, and a glass of whisky-and-water in the course of the evening—for reasons presently to be explained—does far more injury to his constitution than one who partakes of a larger quantity of alcoholic stimulants at meal-times. That this is not a mere ideal opinion evolved from the realms of fancy, but one founded upon an indisputable basis, I shall show by reference to the tables of mortality furnished by the registrar-general in his annual reports. As there, unfortunately, exist no especial tables of mortality from this form of moderate drinking, I have adopted the plan of estimating its effects on health by comparing the death-

rates given in the reports of persons who, in the course of their vocations, are exposed to the temptation of taking small quantities of alcoholic stimulants between meal-times, with the recorded death-rates of those, at the same ages, whose trades and modes of life do not so expose them. And the results are, I think, perfectly conclusive. For they not only furnish us with a comparative absolute average death-rate in the two sets of cases, but, in no ambiguous language, point out the exact organs of the body that are most affected by nipping, and give us the relative proportions of the deleterious influence it has upon each of them.

First, then, as regards the influence of "nipping" on the liver and kidneys—the two organs of the body not only more immediately affected, but most closely corelated, from the fact that when the one is diseased the other has to perform its functions, as best it can, vicariously. Seeing that the average proportion of drunkards is about the same in all industries, when it is considered on such a vast scale as over the whole nation's strength, I scarcely think any one will doubt the trustworthiness of the results as revealed in the subjoined tables: *

Death-Rate of Men between the Ages of 25 and 65.

Men exposed to the temptations of "nipping."	Liver diseases.	Urinary diseases
Commercial travelers	61	44
Brewers	96	55
Innkeepers, publicans, vintners, barmen, and waiters	240	83

The comparative death-rates of men of the same age engaged in other industries, not exposed to the temptation of "nipping," are, again, as follows:

Death-rate of men not exposed to the temptations of "nipping."	Liver diseases.	Urinary diseases
Gardeners and nurserymen	18	39
Printers	28	30
Farmers and graziers	41	31
Drapers and warehousemen	35	37

As an addendum to these most telling statistics, I think I can not do better than quote what Baer says regarding the probabilities of life in persons exposed to the temptations of "nipping" compared with that of those not liable to be so tempted. The following is extracted from his table of Prussian statistics.† and I arrange them for the sake of easy comparison in two parallel columns, showing the probable duration of life calculated at different ages:

* "Supplement to the Forty-fifth Annual Report," 1885, p. 32.

† "Deutsche med. Wochenschrift," January 20, 1887.

AGE.	PROBABLE DURATION OF THE LIFE OF MEN.	
	In the liquor trade.	Not in the liquor trade
25	26·23	32·08
35	20·01	25·92
45	15·19	19·92
55	11·16	14·45
65	8·04	9·72

This, as is seen, is an equally instructive table.

To return for a moment to the part played by the so-called moderate use of alcoholic stimulants in the production of fatal forms of liver-disease. As it is, I think, impossible that we as medical men can know too much regarding the probable deleterious effects of mere "nipping," I here subjoin an extract from the registrar-general's tables of the comparative mortality from liver-diseases in different industries, between the ages of twenty-five and sixty-five, in the years 1880–'82, which exhibits the matter in a stronger light than any words of mine can possibly do:

Bookbinders	3	Butchers	21
Booksellers	4	Fishermen	22
Hatters	9	Brewers	42
Tobacconists	10	Innkeepers, publicans, vintners, waiters, and barmen	197
Druggists and printers	18		
Gardeners and miners	19		

The result here shown is so startling that the registrar-general not inappropriately designates it as "appalling," seeing that the proportion of deaths from liver diseases is in reality six times greater among men exposed to the temptations of "nipping" than in that of all the other industries combined—the actual figures being: For brewers, 1,361; for vintners and other salesmen of wines, spirits, and beers, 1,521; and for waiters and barmen (those most exposed to temptation), no less than 2,205; whereas, for maltsters, who are only concerned with the materials from which intoxicants are manufactured, and not with the intoxicating liquids themselves, the death-rate is only 830. Nothing could be more conclusive of the deleterious effects of so-called moderate drinking on the human constitution than this; for, as all different effects in this world originating in identical causes are but relative, it is readily seen how a lesser proportion of "nipping," though giving rise to lesser results, must nevertheless cause a proportionate amount of cases of disease in the liver and kidneys to those given in the above tables.

Notwithstanding the familiarity of medical men with the fact that many cases of hepatitis, chronically enlarged liver, and cirrhosis are directly traceable to inebriety, few, I fancy, can have

been prepared, without some special acquaintance with the subject, for the information furnished by the foregoing mortality tables of the potent action of alcohol on the liver, when only taken in small quantities at a time. And, although it may at first sight appear strange that the liver of all the organs of the body should be most potently affected by moderate drinking, I think one can scarcely be surprised at this if he is acquainted with the peculiar action of alcohol introduced into the liver by the portal vein. For it requires, I think, but a small amount of reflection on the part of those acquainted with the mechanism of digestion to understand how alcohol, when taken into the stomach, even in small quantities at a time, is a powerful agent in the production of hepatic disease. Seeing that most of the liquid products of our food are carried directly from the intestines to the liver by the portal vein, it consequently follows that almost every drop of the alcohol, be it small or be it great, taken into the stomach must be directly conveyed by the portal vein to the liver, and compelled to filter through its tissues before it can possibly get into the general circulation and reach any of the other organs of the body. The knowledge of the fact that all the imbibed alcohol is directly conveyed to the liver by the portal circulation not only gives a clew to why alcoholic stimulants are so prone to induce hepatitis, as well as to increase the formation of sugar and aggravate diabetes, but to bring about an attack of gout; seeing that the liver is regarded as the main source of both sugar and uric acid—the supposed gout-forming material. In addition to which, the direct conveyance of alcohol to the liver affords us a reasonable explanation of why alcohol taken along with the food is so much less detrimental to the constitution than when it is taken on an empty stomach. Moreover, it is now a well-known fact that the continuous excitement of the liver, kept up by habitual "nipping," is far more injurious to its functions than an occasional outburst of drunkenness followed by intervals of strict sobriety. It equally accounts for the fact that the liver is not alone the first organ of the body that becomes affected, but is at the same time the one most seriously disordered by moderate drinking.

The effects on the kidneys of moderate drinking are far less apparent than upon the liver; nevertheless, they are sufficiently marked to merit attention. The reason why the kidneys suffer so much less from the imbibed alcohol when it is taken in only small quantities at a time is sufficiently obvious, seeing that a large quantity of what passes through the liver never reaches the kidneys at all, from a considerable part of it having been eliminated by the breath during its passage in the blood through the lungs. That intemperance is a fruitful source of Bright's

disease has long been known, and the reason of this is not far to seek, seeing that it is the special duty of the kidneys to eliminate alcohol from the general circulation—as they do all other foreign materials. And the more work that is thrown upon an organ, the more prone are its tissues to become degenerated. Not only, however, do we know that the kidneys eliminate the imbibed alcohol (from its being met with in urine), but we likewise know that alcohol, as alcohol, saturates the renal tissue to such an extent that I and others have been able to obtain pure alcohol from the kidneys of persons who have died intoxicated by the simple process of distillation. Besides all this, however, there is a special reason why the kidneys should become diseased in so-called moderate drinking; and that is on account of the circulation being incessantly increased in them, as it is elsewhere, from the accelerated heart's action induced by the repeated imbibition of stimulants in small quantities. For no doubt the diameter of the renal blood-vessels is augmented by their engorgement, and consequently they exert a deleterious pressure on the intervascular tissues, which will interfere with their proper nourishment. While, further, this engorgement of the renal vessels will render the kidneys more liable to the injurious effects of chills; and chills are, as is well known, the most fruitful cause of kidney disease. This view of the case appears to me to give not only the clew to the reason why Bright's disease is so particularly common among the inebriate, but likewise why transient attacks of albuminuria are so frequently met with in moderate drinkers, among both men and women. Spirit-drinking is said to be mainly instrumental in inducing the variety of renal disease named granular kidney; while beer-drinking is, on the other hand, thought to be most potent in bringing about fatty degeneration of the renal tissues. Be that as it may, I well know, from a long experience of urinary affections, that even small quantities of alcohol habitually indulged in sometimes bring on most troublesome forms of albuminuria, without there being any well-marked symptoms of the existence of either granular or fatty degeneration of the tissues of the kidneys.

Alcohol, when taken in small quantity, is in general said to act as a direct cardiac stimulant, and its stimulating effect is supposed to be due to its possessing the faculty of increasing the muscular power of the heart. I take an entirely different view of the matter, and shall now endeavor to show how the increase in the force of the heart's movements, the quickening of the pulse, the flushing of the face, the congestion of the retinal blood-vessels, as well as all the other visible appearances of accelerated cardiac functional activity, are in reality in no wise due to the stimulating action of alcohol, either on the heart's

muscular tissue or the nerves supplying it, but actually to the very reverse—namely, its paralyzing effects on the cardiac nerve mechanism. This may appear a strange idea to those unfamiliar with the advanced theories regarding the accelerating and restraining heart's nerve-forces. Nevertheless, it is quite consonant with the results of modern physiological investigations, which go far to prove that every function of organic life—no matter whether it be the expulsion of the urine, the peristaltic movements of the intestines, the throbbings of the heart, or involuntary respiration—acts under the immediate influence of a bifold nerve mechanism. For example, the human heart is endowed with two entirely different and opposing centers of nerve-force, and so retroactive are their respective functions that the sole duty of the one appears to be to regulate and control the functions of the other. To the former has been given the name of inhibitory or restraining mechanism; to the latter that of the exciting or accelerating nerve agency. Destroy or paralyze the inhibitory nerve-center, or arrest its power of communicating with the heart by dividing the vagus, and instantly its controlling effect on the cardio-motor mechanism is lost, and the accelerating agent, being no longer under its normal restraint, runs riot. The heart's action is increased, the pulse is quickened, an excess of blood is forced into the vessels, and from their becoming engorged and dilated the face gets flushed and the retina congested—all the usual concomitants of a general engorgement of the circulation being the result. Instead of paralyzing the vagus by section, and thereby arresting its inhibitory cardiac nerve-power, paralyze it through the instrumentality of a toxic agent, and precisely the same chain of phenomena will of necessity be the result. The most powerful paralyzer of the vagus we at present know of is atropia; and what happens when it is given in a full dose? Nothing more or less than the effects we have here attributed to the section of the vagus—tumultuous heart's action, quickened pulse, congested face and eyes, etc. Alcohol acts on the heart, I believe, in precisely the same manner as atropia does, although less strongly; that is to say, it quickens the heart's action, as well as apparently increases its power, by paralyzing its restraining or inhibitory nerve mechanism. This, however, is only the primary action of alcohol on the cardiac organ, for no sooner is the quantity administered sufficiently increased than all its at first apparently stimulating effects vanish. From its now possessing adequate power to paralyze the accelerating as well as the retarding cardiac nerve mechanism, the heart's action, therefore, now becomes diminished *pari passu* with the amount of the paralyzing agent employed, until at length (if a sufficiency be given) the cardiac

movements are totally arrested, and death closes the scene. Effects on the human organism being, when properly interpreted, like effects in the inorganic world—exactly proportionate to cause—the at first sight apparently stimulating and consequently salutary action of alcohol on the heart, when taken in moderation, is as much due to the alcohol's paralyzing power as the destruction of all vital action is its result when it is taken in poisonous quantities. From this, however, it is not to be inferred that its incipient paralyzing power over the inhibitory cardiac nerve mechanism must necessarily be in all cases detrimental. On the contrary, it may actually in many instances be beneficial. Just in the same way as atropia, strophantus, digitalis, and daturine—which are all cardiac inhibitory nerve paralyzers—prove exceedingly useful medicinal agents when they are judiciously employed in appropriate cases. So alcohol, by the doctor's skill, may in like manner be so used as to paralyze to cure, and not to kill.

It being well known that intemperance is a most fruitful cause, not only of all the various forms of heart-disease, but likewise of the degenerations of the coats of the blood-vessels, all I at present require to do is to prove that even what is called moderate drinking has a much greater share than is generally supposed, in not only greatly increasing heart-diseases, in cases where they already exist, but also in inducing their development in the constitutionally and hereditarily predisposed to become affected by them. The reason why moderate drinking should induce not only hypertrophy and dilatation, but likewise valvular disease of the heart, is not far to seek—from its being a recognized fact that every increase in a muscle's activity is associated with an increase in its development, as well as its tension on the parts with which it is connected. The truth of the foregoing statements will, by a little reflection, be gleaned from the results of drinking small quantities of alcohol frequently during the day, as manifested by the figures in the subjoined table of mortality I have drawn up from the registrar-general's reports,* of the relative frequency of diseases of the circulatory system among men between the ages of twenty-five and sixty-five employed in different industries. For it not only shows the effects of so-called moderate drinking *per se*, but likewise the still more pernicious effects of it when it is associated with intermittent muscular strain—that is to say, when the stimulus of alcohol upon the heart has superadded to it an increase in the heart's activity necessitated by oft-repeated sudden muscular

* Supplement to the forty-fifth Annual Report, 1885, which takes in the whole previous ten years' death-rates, and may consequently be accepted as yielding a reliable average.

efforts; for while it shows that all exposed to the partaking of alcoholic stimulants in small quantities at a time are much more frequently affected with the fatal forms of cardiac diseases than others, it in an equally unmistakable way shows that men who, like brewers, require in the course of their trades to tax their muscular strength, and thereby throw additional work upon their hearts, are far more often attacked with the fatal forms of diseases affecting the circulatory system than men equally addicted to imbibe alcoholic stimulants, but who are not called upon to make similar kinds of straining muscular efforts.

The relative proportions of deaths from diseases of the circulatory system in the different classes are:

Those not exposed to the temptation of drinking.		Those exposed by their vocations to the temptation of drinking.	
Drapers and warehousemen	75	Commercial travelers.....	100
Gardeners and nurserymen	82	Vintners, waiters, and barmen	146
Printers	93	Brewers	165

Moreover, it is equally known that intemperance is a most active agent in the induction of atheromatous (fatty granular) degenerations in the coats of the arterial system, and as such a fruitful source not only of death by cardiac syncope, but likewise by apoplexy, from the cerebral vessels being quite as frequently and as severely affected with the degeneration as those of the heart itself, and the coats of the one set being as liable to sudden rupture as those of the other, if not, indeed, even more so, from the less solid nature of the brain surroundings. I wish now to call special attention to what I believe to be a fact—namely, that what is termed "moderate drinking" is a far more general cause of atheromatous degeneration of the coats of the blood-vessels than is usually supposed.

It is, I believe, next to impossible to overrate the desirability of impressing patients laboring under heart-disease, as well as atheromatous degenerations of the blood-vessels, with the absolute necessity of being extremely temperate in the use of alcoholic stimulants, if they wish either to live long or to ameliorate the disease of the circulatory system under which they labor. For alcohol taken in the form of spirits—brandy, whisky, gin, or rum—even in teaspoonful doses, by increasing the heart's action has quite as pernicious an effect on the organic structural disease, be its form what it may, as belladonna itself. And I fancy all who have much experience with cardiac diseases know well the intrinsic significance of this remark.

In the early stages of organic disease of the heart or blood-vessels judicious regimen is quite as essential to the well-being of the patient as wise treatment: for, if the case be skillfully handled, it is not only possible for death to be long averted, but

even the effects of the organic changes reduced, and, like the cracked jug which goes often to the well, the life of the patient may be prolonged for years; while, on the other hand, if the true nature of the case fail to be early recognized, and the patient goes on living as if there were nothing the matter with him, the disease rapidly advances, and ere long the time arrives when it is utterly beyond human power to avert a more or less suddenly fatal ending.

After having so forcibly pointed out the baneful effects of even small quantities of stimulants in diseases affecting the heart and blood-vessels, I think it is time for me to show that in these cases the laws of therapeutics are not, like those of the Medes and Persians, unalterable. This arises from the fact that even the same forms of organic disease affecting the circulatory system occasionally differ very materially in their characters as well as in their course, not only from the special constitutional peculiarity of the patient, but likewise in a marked degree from the different circumstances under which he is placed; so that stimulants may be employed in one case as a useful adjunct to other treatment, in spite of their being absolutely forbidden in another. In all cases, however, their employment can only be sanctioned under medical advice, for, from its being always much easier to put a thing wrong than to set a thing right, therapeutical combined with pathological knowledge can alone be safely intrusted to decide whether or not alcohol can be given with either advantage or with safety in any given case of cardiac disease. Even here, however, some general rules for alcoholic treatment can be notified; for there is no doubt whatever that, in all cases of cardiac syncope, spirits, in the shape of brandy, rum, whisky, or gin, are potent heart revivers, especially when there exists no actual organic disease of the organ. And even in certain cases where there are valvular derangements alcoholic stimulants may be had recourse to with marked benefit. Moreover, from the fact of alcohol being a powerful anti-flatulent, there is scarcely a single case of organic disease of the heart in which it may not sometimes be administered in small quantities at a time with marked advantage.

Finally, I think it may be said that the various facts adduced appear to prove—1. That alcohol, when indulged in, even well within the limits of intemperance, has a most prejudicial effect on heart-disease. 2. That sudden spurts of muscular exertion act most deleteriously on all forms of organic cardiac affections. 3. That mental excitement is a cause of rupture of atheromatous blood-vessels. 4. That a mere extra-distension of a stomach by wind may suffice to fatally arrest a diseased heart's action. The knowledge of these facts has for some years past led me to make

it an invariable rule to impress upon all patients laboring under diseases of the circulatory system, who desire to minimize the effects of their complaints and ward off as long as is possible the inevitably fatal termination, to pay strict attention to what I call the following three golden rules: 1. Take exercise, without fatigue; 2, nutrition, without stimulation; and, 3, amusement, without excitement.

As the consideration of the effects of alcohol on the brain, when taken in excess, lies entirely outside of the scope and purport of this essay, I at once proceed to call attention to the as yet but imperfectly known subject of the influence of small quantities of alcohol on brain-diseases. And it being my desire to make the effects of moderate drinking as strikingly apparent as is possible, as there are no statistics of the effects of it forthcoming, I fall back upon the data furnished in the registrar-general's reports regarding the comparative ratio of mortality from diseases of the nervous system occurring among men between the ages of twenty-five and sixty-five in different industries. For they tell so startling a tale of the baneful effects of taking small quantities of alcoholic stimulants frequently during the day, that no one accustomed to analyze results deducible from collateral evidence can fail to appreciate their intrinsic value in the elucidation of the point in hand. The registrar-general's report* tells us that the relative mortality is as follows:

Men exposed to the temptations of "nipping."	Diseases of the nervous system.
Commercial travelers	139
Brewers	144
Innkeepers, publicans, wine, spirit, and beer dealers	200

Men not exposed to the temptations of "nipping."	Diseases of the nervous system.
Gardeners and nurserymen	63
Farmers and graziers	81
Printers	90
Drapers and warehousemen	109

The above figures speak to the reflecting mind in no ambiguous language, so that I need make no comment upon them save to call special attention to the fact of diseases of the nervous system being so much more common among drapers and warehousemen than among the equally indoor occupation of printers: the only tentative explanation which I dare venture to adduce from this fact being that, as it is worry, little fidgeting mental worries, that conduce more than mental work (not excessive) to shatter the nerves, the high percentage of diseases of the nervous system met with among drapers and warehousemen is possibly due to their being more liable to be mentally harassed in the

* Supplement to the forty-fifth Annual Report, 1885.

course of their daily vocations than printers, who are as a rule not subjected to anything like a similar class of petty annoyances during their work, no matter how arduous it may be.

That after the liver and the heart the brain should be the next organ of the body which suffers most from the injurious effects of alcohol when taken in small quantities at a time is no more than what might be expected. Indeed, I think it is even less, seeing that alcohol acts injuriously upon nerve-tissues in three distinctly different ways: First, through its chemical action upon the blood; second, by disordering the liver's functions and causing the bile to accumulate in the circulation, and thereby poison the brain and nerves; and, third, by its accelerating the heart's action, and thus sending an increased supply of blood to the brain—every increase in an organ's blood-supply being associated with a corresponding increase in the functional activity of the organ.

The increase of the cerebral circulation consequent upon the increase in the heart's action from the imbibition of small quantities of alcohol acts prejudicially, however, upon the brain in yet another way—namely, by its causing an engorgement and dilatation of the cerebral arteries. For, seeing that Nicol and Mossop found that so small a quantity as two teaspoonfuls of absolute alcohol caused marked congestion of the retinal blood-vessels—which derive their blood-supply from the same source as the cerebral vessels—it is natural to infer that even the small quantity of two teaspoonfuls of alcohol will induce the same amount of congestion in the branches of the blood-vessels within the cranium as it does in those immediately outside of it; and if so, seeing that the organ is confined within a limited space and surrounded on all sides by unexpansible ridged walls, by their engorgement and dilatation they must of necessity press injuriously upon the brain-substance. The pressure thus exerted on the nerve-cells and fibers will not only prevent their performing their functions properly, but at the same time interfere with their nourishment, and consequently lead to a degeneration of their constituents. The deleterious effects of congestion of the intercranial blood-vessels are rendered apparent to us in yet another way—namely, by the feelings of fullness or tightness of the head experienced by many persons after partaking of alcoholic stimulants. Moreover, it appears to me that the facts just alluded to afford a reasonable explanation of why it so often happens that persons who indulge in small quantities of spirits while engaged in arduous mental labor frequently suffer from a sudden mental breakdown, notwithstanding that the immediate effect of the stimulants had appeared to be beneficial to them by increasing their brain-power. My explanation of the cause of

the mental collapse is, that the brain, like every other organ of the body, while in a state of functional activity, draws to it a super-supply of blood, and consequently, when alcohol is taken, it adds to the already existing engorgement of the cerebral vessels arising directly from the brain's activity, by accelerating the heart's action, and thereby augmenting its deleterious effects by still further increasing the pressure exerted on the nerve-cells and fibers by the already dilated and engorged vessels.

We shall now for a moment glance at the injurious effects of small quantities of alcohol exerted on the brain through the intermedium of the hepatic derangements that stimulants induce.

The very large number of nerve affections, more especially in the form of intellectual disturbances, which come under the notice of liver specialists, are in a great measure attributable to the disorder of the biliary functions brought about by the habitual indulgence in small quantities of alcohol between meal-times; for, as is well known, scarcely a more formidable cerebral poison than bile exists.

Sometimes one learns from a patient a great deal which he may turn to account in the treatment of others; and one of the things a patient taught me was the marvelously depressing after-effects that a single glass of spirits will occasionally produce in a bilious subject. A leading member of our own profession, who is a martyr to biliousness, made a number of experiments upon himself regarding the depressing after-effects of alcoholic stimulants, and he tells me that he has repeatedly found that a single glass of gin, whisky, or brandy, taken diluted with water, either at dinner-time or in the evening, when he is bilious, and feels exhausted after his day's work, will be followed in from five to fifteen hours with such a morbid depression of spirits that he scarcely knows what to do with himself; yet the primary effect of the stimulant is, he says, not only refreshing but exhilarating. This, although an exceptional case in so far as its severity is concerned, is but the type of many others that have come under my notice; for some have said that a single tablespoonful of brandy, whisky, or gin, will induce depressing after-effects when their livers are out of order.

The only way in which I can account for this depressing after-effect of small quantities of alcohol, when taken by bilious persons, is by imagining that the small amount has the power to exert a more than usual deleterious influence on the cerebral tissues in consequence of their having been already materially weakened by the direct poisonous effects exerted on the nerve-tissues by the bile in the circulation. I am led to this opinion from noticing how much less the depressing after-effects of spirits become so soon as the liver's functions are put to rights.

The brain and liver disorders induced by alcohol thus appear to be as closely correlated as those of liver and kidney. The mere fact of a splitting headache following upon a debauch in the case of a strong, healthy man, and a frontal or an occipital pain succeeding the drinking of a single glass of sherry in a nervously weak one, may be regarded, I think, as proof positive of the detrimental effects of alcohol on the nerve-tissues, as well as lead us to suppose that it is most probably due to the compression of the nerve-cells and fibers, which, as I have above tried to explain, may probably arise from the alcohol accelerating the heart's action, and thereby increasing the circulation in the intercranial vessels.

This statement necessitates the making of another—namely, that atheromatous degenerations of both the cardiac and cerebral blood-vessels are particularly common among men of great muscular and mental activity, who are in general spoken of as "good livers."

I have now to call attention to what appears to be a reverse kind of preliminary alcoholic effect on the nervous system—namely, that which is observed in the incipient stage of intoxication, and is almost invariably spoken of as a pleasant instead of a disagreeable sensation. Although I imagine that when a small quantity of an alcoholic stimulant is taken, the pleasurable feelings experienced may be probably entirely due to its increasing the cerebral circulation, I nevertheless think that when the amount taken is sufficient to be ultimately able to lead to complete unconsciousness, the preliminary stage of the intoxication, which has been described by some as one of sweet *sans souci*, is simply the offspring of a blunting of nerve sensibility—in fact, merely a partial or incipient stage of cerebro-spinal paralysis; precisely in the same way as feelings of a pleasing calm are oftentimes felt to precede the total unconsciousness of refreshing sleep, and soothing sensations of agreeable beatitude have been described as their feelings by persons who after a lingering illness have quietly and peacefully slipped away into eternity. In all of these cases the pleasurable sensations experienced are merely, I believe, due to the gradually increasing negation of nerve-sensibility.

Lastly, as regards the deleterious influence that small quantities of alcoholic stimulants exert upon the brain-tissues through the power they possess of so acting on the nerve-pabulum in the blood as to prevent its taking up oxygen and exhaling carbonic acid, and thereby becoming fitted for the purposes of brain nutrition. Alcohol does this exactly in the same way, though to a somewhat lesser extent, as opium. This is well shown by the results obtained from a series of experiments I performed on the

subject some years ago, a full account of which was laid before the Royal Society, and published in its "Transactions" in 1864, under the title of "The Action of Physical and Chemical Agents upon the Blood, with Special Reference to the Respiratory Process."

The relative effects of alcohol and opium were found to be as follows:

IN 100 PARTS OF AIR.	Oxygen.	Carbonic acid.	Nitrogen.	Vol. at 0° C. and 1 metre pressure.
Composition of employed air	20·9	0·002	79·038	20·96
With pure ox-blood	10·58	3·330	86·09	14·91
With pure ox-blood + 5 per cent of alcohol	16·59	2·380	81·03	18·97
With pure calf's-blood	6·64	3·47	89·89	10·11
With pure calf's-blood + ·005 grm. of morphia	17·17	1·00	81·83	18·17

A glance at this table suffices to show that alcohol, even in the small proportion of five per cent, exerts a powerful chemical effect on blood, so powerful as to entirely derange one of its most important functions—namely, the function of respiration. The alcohol seems to have acted like an asphyxiant, inasmuch as it has not alone diminished the power of the red corpuscles to absorb oxygen, but to exhale carbonic acid, and that too in the same way, though to a somewhat lesser extent than morphia does. This peculiar chemical action of the alcohol on the blood nerve-pabulum may be thought to give a reasonable explanation of the paralyzing action of alcohol upon the nervous system, seeing that oxidation is the motor power of all vital action, and in direct proportion to its activity are the manifestations of life accelerated or retarded. Every breath we draw, every movement we perform, every thought we think, is but the outcome of the transformation of matter under the influence of oxygen. If, then, it be true, as above shown, that alcohol possesses the power of preventing the constituents of the blood from being properly oxidized, and thereby fitted for the purposes of nutrition, it is easy to account for its producing a chain of more or less well-marked neurotic symptoms terminating at last in coma and death.—*Abridged from the London Lancet.*

It is urged in behalf of Antarctic exploration that it will promote a needed extension of our geographical and geological knowledge; will contribute to a solution of the question of a connection of the volcanic disturbances in the Sunda Islands and New Zealand along a "weak line" with the volcanoes of Victoria Land; will aid in determining whether any secular climatic change is in progress; and may be the occasion for resuming the magnetic survey of those parts and comparing the results with those obtained by Ross.

A STUDY OF THE AINU OF YEZO.

By J. K. GOODRICH.

FOR many years I have been very much interested in the Ainu* of Japan and Saghalien, and have read carefully everything upon which I could lay my hand containing information about them. Finding that Mr. Batchelor says, "Miss Bird's remarks upon the Ainu are perhaps the best that have been written in English,"† I came to the conclusion that anything like a satisfactory knowledge could only be obtained by visiting, as she did, some of the Ainu villages of Yezo. My desire to see them for myself has always been stimulated by the rather conflicting statements about them which are found in different books, and I have always had a sort of a forlorn hope (as I thought it) that fortune would some time turn me back to the shores of Asia, which I left nearly twenty years ago.

This long-wished-for opportunity has at last been granted. I landed in Japan the second time in the spring of 1886, and after waiting only long enough to get a slight working knowledge of the language, I spent a good part of the summer of 1887 in roaming about the northern parts of the empire, and have been permitted to see, live with, and study the Ainu in their homes. The Japanese officers have made special efforts to afford me facilities, and have enabled me to do much more than I could have done without their aid in so short a time.

I have learned of the Ainu history, of their habits and customs, of their myths and superstitions, from *the* man in Japan who is admitted to know this people better than any other person; and I here wish to thank the Rev. John Batchelor, Church Missionary Society, Hakodate, for his kindness, and for the patient way in which he submitted to my cross-questioning; for the advice he gave me how to make the best use of the limited time at my disposal, and for the assistance he rendered in making what is at the best a rough, hard trip as easy as possible. To Mrs. Batchelor my thanks are due for creature comforts which supplemented the trying fare of Japanese inns most acceptably.

I do not hesitate to say that all the *valuable* information contained in these notes has come originally from Mr. Batchelor; and that I have only confirmed what he has told me by my own observation, or by questioning the people themselves, when I found some who understood Japanese. Perhaps it would be

* I adopt the spelling of the name which the Rev. Mr. Batchelor favors, as I yield precedence to him in all matters of exact knowledge concerning this people.

† "Unbeaten Tracks in Japan," by Isabella L. Bird.

better for me to leave Mr. Batchelor to tell his own story about the Ainu, but a missionary who is working single-handed (practically) over the extent of territory which he is trying to cover, can have but little time for ethnological work, and one wonders how Mr. Batchelor has managed to put together even the few stray bits that have come from his pen.

In the villages of the southern and eastern coasts of Yezo, nearly all the men (and many of the women and children) speak Japanese well. Hence it is always easy to get information from them; but, though deserving in a large measure their character for honesty and truthfulness, the Ainu have become sufficiently civilized to thoroughly love "taking a rise" out of a stranger—and if a bit of a lie will make the inquisitive one's eyes pop open and his pencil and note-book spring into unusual activity, the "gentle, truthful savage" is not going to spoil a good story by sticking to dry facts.

In the extreme northern and northeastern coasts of the island, and in the mountain fastnesses of the interior, there are still some villages of Ainu (not great numerically, but preserving their integrity) in which the people have quietly but firmly resisted Japanese advances and civilization. In those places many of the inhabitants can not speak Japanese. They use a few household utensils of Japanese manufacture, but, with this exception, continue to live as much as possible as they did before they came into contact with the Japanese. This seclusion can not last long now, however, for the Japanese are pushing their way slowly but surely (and of late it may be said *kindly*) into every nook and corner; establishing police stations and customs barriers, and fast breaking down the last trace of distinctive lines between the two races. There is a marked difference between—what I may call—the civilized and savage Ainu, and therefore he who would see something of them in anything like their natural condition must come quickly.

It is not my present purpose to discuss this people exhaustively, but merely to present a brief ethnological sketch of them in such a form as may be found interesting to the general reader, which may serve as a skeleton for me or some one who may have time and opportunity to deal with the subject thoroughly, to fill out in the near future.

There are very few tribes remaining on the earth who are as interesting in themselves as the Ainu; and none, perhaps, about whom so little can ever be known. Without a literature, without any monuments or reliable records, dreading to speak of the dead or the acts and deeds of their ancestors, they must be taken as they are, and speculation as to what they have been will always be more or less unsatisfactory.

Their number can not be given with the least degree of satisfaction. The Japanese Government census is not correct, nor is it claimed to be. Individual estimates range from 15,000 to as high as 50,000, but I fancy 16,000 or 18,000 would be about the number of Ainu in the empire of Japan. It is rather satisfactory to learn, from those who have been among the Ainu of late years, that they are holding their own, if not actually increasing in population. They may have survived their usefulness, though it is not easy to say just what that usefulness has been; but the same reason for alleging that they now but cumber the earth can not be advanced in their case that has been charged against the North American Indians (with whom the Ainu have been compared, though upon what grounds I can not see). The Indian is naturally a bloodthirsty savage, while a more peaceful, law-abiding race than the Ainu can not be imagined. In my general opinion of the Ainu I hold a middle ground between Miss Bird's enthusiasm, which makes him a gracious courtier, and the contempt of most Japanese who say, "The Ainu are just dogs, and have no souls."

The people know themselves as Ainu—*Ainu utara*. *Ainu* is singular, and *utara* is a plural suffix: Ainu, however, is often used when speaking of them collectively. Inasmuch as the Japanese word for dog is *inu*, there is some ground for supposing that the tradition concerning the Ainu descent from a "large white dog" was invented by the Japanese after they became acquainted with the Ainu name for themselves, and was intended to show the contempt of the conquerors for the "vile and ignominious Aino." I do not venture to express any opinion as to the origin of this race of people, since it is a subject about which they themselves know nothing for certain. Batchelor says: "The older Ainu have a tradition to the effect that a person named *Okikurumi*" (who is strongly suspected to have been none other than the Japanese hero *Yoshitsune*—J. K. G.) "was the true Ainu ancestor. He descended from heaven to a mountain in Piratoru many years before the Japanese knew or were known by the Ainu. Okikurumi had a wife who was called *Turesh*, and who is always known by name—Okikurumi Turesh Machi. Okikurumi Turesh Machi bore a son, whom they called *Wariunekuru*, and from Wariunekuru the Ainu are said to be descended. Some of the Sara Ainu say that their forefathers came from the islands which lie to the northeast of Karafuto, or Saghalien, meaning thereby the Kurile Islands. The Kurile-Islanders are said to be 'quite as hairy as the bear,' and this accounts for the hairiness of the Ainu."

I think that the character of the Ainu house would seem to indicate that the people are of southern origin, and have been

pushed toward the north by the aggressive, disciplined Japanese. Plainly they have not been very long inhabiting the island of Yezo, for the traces of their predecessors are too clearly to be seen; and all signs seem to indicate that at a not very remote period they were spread over the whole of Japan: it is certain that within the Japanese historical period they were as far south as the latitude of Nikkó in sufficient numbers to be deemed dangerous. Now, every feature of the Ainu hut points to a southern —one might almost say tropical—origin. The frame is made sufficiently strong to resist a heavy gale of wind, but not to carry a stout weather-boarding or a *light*, substantial roof. It seems to me that the original design of the thick, well-laid thatch was to turn a tropical rain, and that the exigencies of environment have produced a certain change and added strength to carry the weight of snow. Had the Ainu come from the north or northwest, it is probable that they would have brought with them a style of architecture adapted to a rigorous climate; that the roof would have been light but strong, and the walls sufficiently thick to break the force of the gales which are known to sweep over the regions of northern Asia. One of the strongest evidences that the Ainu hut is of southern rather than northern origin is the light, thin wall. In this respect it closely resembles the habitation of the East Indies. The low, overhanging eaves is another indication which supports this opinion. The Ainu have never displayed imitative powers, or even the faculty of adapting themselves to their surroundings; hence it is not surprising that they have chosen to accustom themselves to withstand the cold instead of remodeling their habitations.

Another argument to be adduced in support of the opinion that the Ainu are of southern origin is the fact that the girls mature early. I was unable to get any reliable statistics on this point, and depended upon my own observation and that of others. The climate of Yezo, and indeed of all of Japan—with the possible exception of the southern part, the island of Shikoku, for example—is not sufficiently hot to cause the early maturing which is *conspicuous* among the Japanese, and *noticeable* among the Ainu. In Japan, mothers of fourteen are by no means uncommon; and, although the Ainu women do not usually marry before they are probably sixteen or eighteen, they are fitted for maternity long before that age.

Warfare was most irregular with the Ainu. In the case of internecine strife the village chief was the nominal commander, but every person who took part in the engagement conducted his battle after his own fashion. In fights between villages men engaged against men, women contended with women, and even children did battle with children. Internal warfare was not

characterized by the wholesale butchery and merciless slaughter of women and children that is usually so marked a feature of savage warfare. In a foreign war—e. g., against the Japanese—the chief of Sara, who was the recognized head of the nation, assumed command of all the combined forces, the village chiefs acting as colonels. But the utter want of discipline militated heavily against the Ainu, and this undoubtedly was one of the leading causes of their defeat, numbers being a secondary consideration. With the greater strength and superior power of endurance of the Ainu, had they been drilled in concerted action by skillful officers, such as the Japanese generals have been since the time of authentic history, and taught to make the most of their numbers, it can hardly be doubted that they would have made a much better showing than they did.

The language of the Ainu is entirely different from the Japanese. Many "click" sounds are heard, and it is much more consonantal, and there seems to be much less objection to the consonant ending of a word, which is so cordially hated by the Japanese. In the use of pronouns the Ainu language would be considered as philologically in advance of the Japanese, as they are used to indicate the antecedent or person in many instances where Japanese would leave the determination of the person speaking, spoken to, or spoken of, to the context and to the form of the verb. Honorific and humble forms of the verb are not used. The emphasis is similar to that of Japanese; intonation does not always convey the same shade of meaning—that is, interrogation, exclamation, etc.—as in English, although stress is often indicated by an explosive sound.

The tone of voice is always lower and more musical than that of the Japanese, and in the case of younger women is really quite pleasing. One peculiarity of the speech of women is a drawing out of the final vowel of words ending in *a* or *e*. At times this approaches the long *a-a-h* or *e-e-h* of a contented little baby.

The Ainu have been called the hairy people, and, contrasted with the Japanese, the name is well given; still, I could not find any of the animal-like pelts I had been led by some authors to expect to see. The men have heavy, coarse shocks of black hair on the head, cut off short behind across the nape of the neck, and allowed to grow nearly to the shoulders on the sides, being roughly brushed to either side from the forehead. Their beards are very strong and quite long, being allowed to grow without restraint. Most of them have "mossy breasts," and a few have a furry growth on the shoulders and down the back, but not more than I have seen on the shoulders of coolies in the south of China; while for hairy growth on legs and arms, I have seen Caucasians as well covered as any Ainu that *I* saw.

In stature they are rather under the average of the Caucasian, nor do they seem to be as tall as the southern Japanese, but upon this point I am not prepared to make any positive statement, as I took no measurements. Batchelor says: "Their men would measure about five feet seven inches in height. . . . Their foreheads are high, and the facial angle measures about 70°." I can not but think this is rather taller than the average; for one young man who seemed quite a giant among his fellows could not have been more than five feet eight inches in height. Their proportions are good, and the men are both stout and squarely built, the whole appearance being rather more attractive than that of the Japanese of the same relative standing. Their attractiveness, however, does not tempt one to anything like familiarity, as in their personal habits they are the very personification of dirtiness. Washing of person or clothing for the sake of cleanliness never seems to be considered of the slightest importance to them. In warm weather the younger people are tempted to cool off a bit by bathing and swimming in the rivers or salt-water estuaries near the villages; but, during all of my experience (and this is fully confirmed by the statements of others who have had longer knowledge of them), I never once saw a man or a woman performing anything like ablutions in an Ainu village. When brought under civilizing influences, they adapt themselves to their environment, and make very good servants.

An old custom of the people forbids an Ainu woman exposing her person in any way. Some go so far as to say that they must not be unclothed even in private. Consequently, the girls whom I saw in bathing wore their cotton gowns, cut in the shape of a shift, while the boys were without clothing of any kind, though some of them wore amulets (of Japanese origin) tied around their necks.

I was particularly struck by the shapeliness of the Ainu limbs and extremities. Some of the women had small hands and feet, attached to well-turned wrists and ankles, whose symmetry and delicacy of shape dirt could not hide. The color of the skin seems to be darker than that of the Japanese, but just how much of this is due to exposure, and how much to their antipathy to water and utter ignorance of soap, it is impossible to even guess.

The face is round and broad, and although it is lacking in length as a rule, yet in many instances the chin is not badly shaped; the lips are large without being disgustingly gross; the eyes are dark-brown in color, and rather larger than those of the Japanese, without any drooping of the inner corner of the upper lid, and hence appear to be straight, without any of the obliquity which characterizes the Mongolian eyes; the cheek-bones are

high, but not specially prominent; the nose is usually large, and, in the men, oftentimes indicates a strength of will which is not confirmed by the character of the people; the forehead is high and broad, sometimes overhanging to such a degree as to intensify the apparent lowness of the base and bridge of the nose, and I think this fact has led most observers to overlook a certain shapeliness of that member. The faces of the men impress one with their appearance of dignity, the long hair and the flowing beard giving them a truly patriarchal look. When in repose the face is apt to have an appearance of sadness, for the eyes—except when hunting or aroused by some momentary excitement—are rather dull and expressionless. This appearance of sadness is particularly noticeable in the younger people and children, but it is very evanescent, and disappears instantly when anything is said or done in the least likely to provoke a laugh; then the face breaks into smiles, and presents a singularly attractive aspect. Though naturally as shy as a young fawn, even the little children will respond with a laugh to a kind word and smile from a foreigner. I do not understand their language at all, and therefore can not speak authoritatively, but I do not think that I was ever called by foul names in an Ainu village. One can usually tell by the tone and manner, and the reception of the insult by others, whether or not opprobrium is being shouted after one. I can not say the same of all the Japanese places I have visited.

The robustness and general physique of the Ainu may be due to the fact that—so far as known—they have always eaten meat freely; whereas their neighbors and conquerors, the Japanese, have been practically vegetarians for many centuries—fish, a little fowl, and rarely a bit of game, not being a sufficient compensation for the absence of solid flesh from their regular diet.

No exact idea of the shape of the Ainu *men's* heads can be formed from their appearance, for the hair forms a heavy shock, standing out all around; but when the *women's* hair is dressed, their heads seem to be rather small and shapely, and well set on necks which are often long and graceful.

The women certainly have larger hips than the Japanese women. This may be due to their never having used the tight dresses, with the strong under-bands and enormous belts (*obi*) which are swathed around the Japanese girl when she is yet very young. In freedom of motion, in elasticity of gait, and in grace of carriage, the Ainu woman, with all her dirt and rags, is in pleasing contrast to the awkwardness of her Japanese sister in purple and fine linen!

Almost the first thing to attract the attention of a stranger visiting an Ainu village is the tattooing around the mouth of

the women and girls. At the first glance one is deceived into supposing that the *young men* wear very delicate mustaches and train them carefully! As there are no written records of any kind among the Ainu, no means of communication except oral, it is impossible to get at anything like a satisfactory explanation of this curious and thoroughly disfiguring custom. The people themselves say that they adopted it from the people whom they found in possession of the land (Yezo) when they came to the island *from the West* (?). Those people, the *Koropok-guru*, they say were smaller than themselves, and were very soon and easily subjugated; but, evincing a kindly disposition, and a desire to affiliate with the new-comers, rather than to continue to wage war upon them, they (the Ainu) met their overtures half-way, ceased to fight them, and adopted some of their customs, one of them being this curious tattooing. The process commences when a girl is about ten years of age. A woman makes a number of small cuts with a sharp knife on the lips and around the mouth, deep enough to cause the blood to flow freely. With some of the blood, and soot obtained by catching on the bottom of an iron pot, or anything else which may come handy, the smoke from burning birch-bark, a paste is made and well rubbed into the incisions. After the resulting inflammation has subsided, a number of blue marks are seen, and the process is continued until the girl becomes a woman, when the mouth presents the appearance of being surrounded by a growth of hair trained into the dainty mustaches of a most consummate dandy. The tattooing around the mouth covers about one half of the lips, so that when the mouth is closed they appear of rather a sickly color. In the mean time the tattoo-marks have been applied to the forehead, and a heavy line drawn just over the bridge of the nose to connect the eyebrows (which are not shaved off, as *was* the universal custom among the married women of Japan),* and on the back of the hands and up the forearm to the elbow in a rude geometrical pattern.

Although the Ainu now use Japanese cotton and hemp as materials for clothing whenever they can get them, they still are compelled, at times, to resort to the material called *attush*. This is "the inner bark of a kind of elm, possibly *Ulmus montana* of Franchet and Savatier's catalogue of Japanese plants, generally known in Yezo as *Ohiyo*, but the true Ainu name of which is *At-ni*, attush meaning 'elm-fiber.'" It is thoroughly hackled, then spun (or drawn out into strands), and afterward

* This custom is rapidly disappearing from the neighborhood of the treaty ports, and to some extent in the interior, as is also the still more disfiguring sign of a married woman, viz., the blackened teeth. With them are going the short queue and partly shaved head of the men.

woven with a small hand-loom, which is held by the toes and a cord passing around the body. This loom is a very rough affair, but in all essential parts is similar to the hand-loom still to be seen in parts of the United States. The cloth is very rough and hard, but extremely durable. The piece is narrow, but just suited to the one pattern of outer garment worn by men and women alike: this is something like the Japanese *kimono*, but higher in the neck, and has more shapely sleeves. It is a long, perfectly straight gown, reaches nearly to the feet, folds across the body, and is secured at the waist by a girdle similar to the Japanese *obi*, but much narrower and nothing like so elaborate. The Ainu are very fond of ornamenting this gown with broad stripes of blue cotton cloth (an inch or two wide), stitched on in geometrical figures with thread, which makes a contrast: these figures are usually put on the front corners, around the neck, on the yoke, and on the sleeves. A burial-robe, which I saw in the Ainu collection of the Satporo Museum, was made of the attush, tan-colored, and ornamented with stripes of Turkey-red (an inch and a quarter wide), stitched with black, and with dark-blue cotton cloth stitched with thread of a lighter shade. The design was straight or at right angles, only one or two slightly curved lines appearing in a most intricate pattern.

The durability of the Ainu coat, with a certain attractiveness about the trimming, makes it quite popular with the Japanese, and as soon as one lands on the island of Yezo the Ainu styles are seen. The sleeves of this coat are much more sensible than those of the Japanese, which are long and constantly flapping about the legs, whereas the Ainu fits rather snugly about the wrist. Like the Japanese, the Ainu married women wear an under-garment, or smock, of cotton cloth; usually this is merely a straight piece of cloth folded around the waist and loins. In winter the Ainu wear skin-clothing, and leggings and boots made of deerskin; the coast Ainu make boots of salmon-skin.

Girdles—or obi—are made of attush or elm-fiber. A woman's obi, which I have, is made of hemp. It is eight feet long and only two inches wide, coarsely woven of large thread, with narrow, dark-blue stripes on the edges and half-way between the edges and middle, and one broader stripe in the center with a light-blue median line. Near each end is a little bit of red as an added ornament. The Karafuto (Saghalien) Ainu women wear girdles made of leather, and ornamented with rings and Chinese *cash*, which they probably get from Mantchooria. The Ainu do not protect their heads and feet at all, except during the winter.

One of the most common things seen in an Ainu village is the *tara*, or strap used for carrying all manner of bundles, and

even children. It is made from attush, the same material as was formerly used altogether for their clothing. One in my possession is eight feet long. The bark has been roughly hackled, and in the center of the strap is braided into four strands, the outer ones three quarters of an inch wide, being about twice the width of the inner ones. Just at the middle for five inches these are caught together by a cross-weaving of blue and white cotton yarn, in a regular lozenge pattern; this is the part which is placed over the forehead when carrying a load. About seven and a half inches from this, toward each end, the four strands are brought together into a round, double strand, by a seizing which crosses itself regularly. This seizing extends for nearly four inches, and then the braiding is continued in a single flat plait for about eighteen inches, when it runs out into frayed ends. In using, the bundle is slung upon the back, the broad part of the tara being brought over the forehead, so that, while the back bears the weight, the forehead keeps the bundle in place.

DARWINISM AND THE CHRISTIAN FAITH.

II.

UP to the point at which we have arrived, a churchman, in accepting Darwinisn, finds no real difficulty. It neither gives nor suggests an alternative for God's primary creation of the world. And though in the "origin of species" it does not offer an alternative for "special creation," a Christian is only called upon to abandon a theory recently admitted into theology for one which is not only soluble in the Christian view of creation, but on grounds both scientific and theological is more in keeping with what we know of God in his present working. Those who have followed the argument of a previous paper will admit Prof. Huxley's statement, that, so far as the "origin of species" is concerned—

> Evolution does not even come into contact with theism, considered as a philosophical doctrine. That with which it does collide, and with which it is absolutely inconsistent, is the conception of creation which theological [*Quaere* scientific?] speculators have based upon the history narrated in the opening of the book of Genesis.

We are prepared even to go further, and to say not only that theism does not lose, but that it actually gains by the exchange. If Darwinism has destroyed the "dogma of special creation," it has destroyed a "dogma" which was a scientific, or rather unscientific, theory, and from which Christianity, like science, should be glad to shake itself free.

3. But the doctrine of natural selection is said to have destroyed the argument from design in Nature. This is a much more serious matter. For a Christian is bound to believe that Nature is the work of an all-wise and beneficent Creator, whom he also believes to be almighty, so that the Christian can not accept the view adopted by Mr. J. S. Mill, and make a division of labor or of territory between God and a power which limits and thwarts him. We propose to state the difficulty here as clearly and as strongly as we can, because we believe that it is the difficulty which presses most heavily upon thinking men at the present time. In the case of Mr. Darwin himself we notice that, while the substitution of derivation for special creation seems even to have strengthened his belief in the grandeur of creation, the substitution of natural selection for Paley's teleology cut away the main argument for believing in a God at all.

We are not surprised, then, to find those who are at least in imperfect sympathy with Christianity rejoicing in the discomfiture of the theologians. Mr. G. H. Lewes's pæan of triumph, in the "Fortnightly" of 1868, is perhaps the *locus classicus* for this view. Prof. Huxley, with ill-concealed exultation, tells us that what struck him most forcibly on his first perusal of the "Origin of Species" was "the conviction that teleology, as commonly understood, had received its death-blow at Mr. Darwin's hands."* Haeckel, in the same strain, says,† "Wir erblicken darin den definitiven Tod aller teleologischen und vitalistischen Beurtheilung der Organismen"; and in his "History of Creation,"‡ "I maintain, with regard to the much-talked-of 'purpose in Nature,' that it really has no existence, but for those persons who observe phenomena in animals and plants in the most superficial manner."

From the insolent dogmatism of Haeckel, and the anti-theological *animus* of Lewes and Huxley, it is refreshing to turn to the cautious and reverent utterances of Charles Darwin. In his letters we are able to trace every stage through which he passed on this question. At Cambridge, *circa* 1830, he read carefully and with "much delight" Paley's "Evidences" and his "Natural Theology," and speaks of the reading of these books as the only part of the academical course which was of the least use in the education of his mind,§ but he "did not trouble about" Paley's premises—i. e., he took the existence of God as a personal being for granted. Later on, apparently between 1836 and 1839, though he still "did not think much about the existence of a personal God," he abandoned Paley's view, and never returned to it:

* "Lay Sermons."

† "Generelle Morphologie," i, p. 160.

‡ Vol. i, p. 19, English translation.

§ "Life and Letters," i, p. 41.

The old argument from design in Nature as given by Paley, which formerly seemed to me so conclusive, fails now that the law of natural selection has been discovered. We can no longer argue that, for instance, the beautiful hinge of a bivalve shell must have been made by an intelligent being, like the hinge of a door by man. There seems to be no more design in the variability of organic beings, and in the action of natural selection, than in the course which the wind blows.*

An incidental allusion, in a letter of 1857,† shows that he had come to look upon a belief in design and a belief in natural selection as alternatives, and mutually exclusive. But here Darwin began to realize the contradiction in which he was involved. On the one side his theory was opposed to Paley's, on the other it was saturated with teleology. "The endless beautiful adaptations which we everywhere meet with,‡ the extreme difficulty, or rather impossibility, of conceiving this immense and wonderful universe, including man with his capacity of looking far backward and far into futurity, as the result of blind chance or necessity,"* the fact that "the mind refuses to look at this universe, being what it is, without having been designed"‖—these had to be set off against "the difficulty from the immense amount of suffering,"▲ and the *a priori* unlikelihood that an omniscient Being should have willed the world as we know it. In 1860, the year after the publication of the "Origin of Species," Darwin had reached the stage of utter bewilderment:

I grieve to say [he writes to Asa Gray] that I can not honestly go as far as you do about design. I am conscious that I am in an utterly hopeless muddle. I can not think that the world, as we see it, is the result of chance; and yet I can not look at each separate thing as the result of design.◊

And in an earlier letter of the same year he says:

I am bewildered. I had no intention to write atheistically. But I own that I can not see as plainly as others do, and as I should wish to do, evidence of design and beneficence on all sides of us. There seems to me too much misery in the world. I can not persuade myself that a beneficent and omnipotent God would have designedly created the *Ichneumonidæ* with the express intention of their feeding within the living bodies of caterpillars, or that a cat should play with mice. Not believing this, I see no necessity in the belief that the eye was expressly designed. On the other hand, I can not anyhow be contented to view this wonderful universe, and especially the nature of man, and to conclude that everything is the result of brute force. I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion *at all* satisfies me.‡

Elsewhere he says of this suggestion, "I am aware it is not logical with reference to an omniscient Deity."‡

* "Life and Letters," i, p. 278. † i, p. 478. ‡ i, p. 279. * i, p. 282.
‖ i, p. 283. ▲ i, p. 276. ◊ ii, p. 146. ‡ ii, p. 105. ‡ ii, p. 247.

It was immediately after the publication of the "Origin of Species" that Darwin set about his work on orchids, in which, more than in any other of his writings, the notion of purpose is prominent; and some ten years later we find him gladly recognizing the inherently teleological character of evolution, which had been pointed out in a review by Dr. Asa Gray. Dr. Gray had written:

> Let us recognize Darwin's great service to natural science in bringing back to it teleology; so that instead of morphology *versus* teleology, we shall have morphology wedded to teleology.

Darwin writes back:

> What you say about teleology pleases me especially, and I do not think any one else had ever noticed the point. I have always said you were the man to hit the nail on the head.*

Here we are brought face to face with the paradox which had been puzzling Darwin. The theory, which destroyed Paley's doctrine of design, or the old teleological doctrine, unconsciously introduced a new teleology. And the gradual recognition of this new fact is alike curious and instructive. In 1864, when the "Origin of Species" had been four years, and the "Fertilization of Orchids" two years, before the world, Prof. Kölliker, an advanced evolutionist, and a strong opponent of final causes, accuses Darwin of being "in the fullest sense of the word a teleologist," and adds that "the teleological general conception adopted by Darwin is a mistaken one."† Prof. Huxley answers Kölliker, and, in defending Darwin, is driven to distinguish between the teleology of Paley and the teleology of evolution. Two years later, in 1866, appeared the Duke of Argyll's "Reign of Law," in which Darwinism was claimed on the side of the doctrine of design; and the next year Huxley, again in criticising a German professor, Haeckel, and his repudiation of teleology, published the remarkable review, some pages from which reappear in the chapter he contributes to Darwin's "Life and Letters,"‡ and which has more than once been quoted in this connection:

> The doctrine of evolution [he says] is the most formidable opponent of all the commoner and coarser forms of teleology. But perhaps the most remarkable service to the philosophy of biology rendered by Mr. Darwin is the reconciliation of teleology and morphology, and the explanation of the facts of both, which his views offer. The teleology which supposes that the eye, such as we see it in man or one of the higher vertebrata, was made with the precise structure it exhibits, for the purpose of enabling the animal which possesses it to see, has undoubtedly received its death-blow. Nevertheless, it is necessary to remember that there is a wider teleology which is not touched by the doctrine of evolution, but is actually based upon the fundamental proposition of evolution.*

* "Life and Letters," ii, p. 367.
† Quoted in "Lay Sermons," pp. 329, 330.
‡ i, p. 554.
* "Critiques and Addresses," p. 305.

Haeckel's denial of teleology is thus shown to prove too much. And the appeal to rudimentary organs against teleology, Huxley points out, places the evolutionist of that day in a dilemma:

> For either these rudiments are of no use to the animals, in which case . . . they ought to have disappeared; or they are of some use to the animal, in which case they are of no use as arguments against teleology.*

We can hardly be wrong in assuming that Dr. Asa Gray had this review of Huxley's in his mind when he spoke of—

> The great gain to science from Mr. Darwin's having brought back teleology to natural history. In Darwinism [he adds] usefulness and purpose come to the front again as working principles of the first order; upon them, indeed, the whole system rests.†

Is there, then, no difference between the old and the new teleology? Is the old argument rehabilitated? Can we say here, as in the triumph of derivation over special creation, that the Christian faith loses nothing and gains much? We are by no means prepared to defend this paradox. The old and rapid argument from Nature to an omnipotent and beneficent Author was never logically valid. To a thinking man its death-knell was sounded by Kant long before the death-blow was given by Darwin. In spite of the reverence with which Kant treats an argument, which he speaks of as "the oldest, the clearest, and most in conformity with human reason," he sees that the very most which could be established by it would be the existence of "an Architect of the world, not a Creator." It must fall very far short of its proposed aim—viz., to prove the existence of an all-sufficient original Being.‡ Modern science has only brought out in its own way and for ordinary people a truth which metaphysicians already knew—viz., that the argument was, as Dr. Gray puts it, "weighted with much more than it can carry. . . . The burden which our fathers carried comfortably, with some adventitious help, has become too heavy for our shoulders."* The older teleologists noted certain favorable instances, and based on them an argumentative structure which the foundation was quite insufficient to sustain; while, if instances of apparent meaninglessness or misery were adduced, they were put on one side with *Dieu le veult.* In the present day a Christian, whether he is an evolutionist or not, has to run the gantlet with an army of facts and arguments of which his forefathers knew nothing. No intelligent man could now write as Paley does:

> It is a happy world after all. The air, the earth, the water teem with delighted existence. In a spring noon, or a summer evening, on whichever side I

* "Critiques and Addresses," p. 308.
† "Darwiniana," chap. iii.
‡ "Critique," Max Müller's translation, p. 535.
* "Darwiniana," p. 374.

turn my eyes myriads of happy beings crowd upon my view. "The insect youth are on the wing." Swarms of new-born flies are trying their pinions in the air. Their sportive motions, their wanton mazes, their gratuitous activity, their continual change of place without use or purpose, testify their joy, and the exultation which they feel in their lately discovered faculties. . . . The whole winged insect tribe, it is probable, are equally intent upon their proper employments, and under every variety of constitution, gratified, and perhaps equally gratified, by the offices which the Author of their nature has assigned to them.*

The Christian of to-day believes, no less firmly than Paley did, that God is omnipotent, and that God is love. But the old *couleur de rose* view of Nature is no longer possible. "Destruction is the rule; life is the exception." The waste is enormous; the suffering terrible. The many perish; the few survive. All down the scale of sentient being, "perfected by suffering" seems written in unmistakable characters. The law of God's work in Nature is indeed *progress*, but progress at a tremendous and, as it seems to us, reckless cost. These are facts for which neither evolution, except incidentally, nor any other theory of Nature, is responsible. But they are facts of which any theory, theological or scientific, must now take cognizance. They are as fatal to the old teleology of Paley as the facts of embryology are to the theory of independent creations. We may still reverently say, "It is God's will," but that is only an admission that we can not explain the facts, or justify them to the reason or the conscience. It may be a necessary, as it certainly is a devout, attitude of mind, but there is in it an undertone of despair.

Evolution is not responsible for the problem. Can it help us in the solution? The old teleology was destroyed by the new facts, and Darwin offers us a deeper and wider view of purpose based upon these facts. We used to start with the assumption that everything exists solely for the good of man. And though we expressed our belief in an all-wise and beneficent Creator, our teleological inquiries would sometimes take the unsubmissive form of *Pourquoi Dieu fait-il tant de mouches?* (Why did God make so many flies?) a question which was popularly supposed to merge itself in that of the origin of evil. The new teleology proceeds differently. It seeks to give a reason for the existence of each species, by fitting it into its place in the genealogical tree, and relating all the species to one another in the unity of the whole. As Asa Gray puts it:

The forms and species, in all their variety, are not mere ends in themselves, but the whole is a series of means and ends in the contemplation of which we may obtain higher and more comprehensive and perhaps worthier, as well as more consistent, views of design in Nature than heretofore.†

* "Natural Theology," pp. 370, 371. † "Darwiniana," p. 378.

So in the case of organs, we believe that "organs have been formed so that their possessors may compete successfully with other beings and thus increase their number."* We fearlessly then ask, in reference to each part, What is its use? And if it is of no present use, we do not say, "The Creator put it there for symmetry, or as part of a plan," but we ask, What meaning has it had in the past? How can we relate it with by-gone if not with existing conditions? If *ontogeny*, the history of the individual, gives us no answer, we fall back upon *phylogeny*, the history of the race. Organs, which on the old theory of special creations were useless and meaningless, are now seen to have their explanation in the past or in the future, according as they are rudimentary or nascent. There is nothing useless, nothing meaningless in Nature, nothing due to caprice or chance, nothing irrational or without a cause, nothing outside the reign of law. This belief in the universality of law and order is the scientific analogue of the Christian's belief in Providence. And, as Prof. Huxley admits, it is an "act of faith," *brought to* Nature, and slowly, and as yet only in part, verified *in* Nature. Yet to doubt that Nature is everywhere rational, and therefore intelligible, would be for a scientific man an act of intellectual suicide.

But if we believe in law and order everywhere in Nature, though there is so much which is as yet hopelessly irreducible to law, and if that belief is read *into* Nature long before we can read it *in* Nature, may we not approach the moral difficulty in the same spirit? For there is here a curious parallel. What our rational nature resents is not the existence of facts which *we* can not explain, but of facts which *have no* explanation; and what the moral nature rebels at is not suffering and pain, but needless—i. e., meaningless—pain, suffering which might have been avoided. And here Darwinism gives us a hint, if it is but a hint: "Natural selection works solely by and for the good of each being."† The arrangement of the world is "generally beneficent,"‡ and "tends to progress toward perfection." But then—

> Without the competing multitude, no struggle for life, and without this no natural selection and survival of the fittest, no continuous adaptation to changing surroundings, no diversification and improvement leading from lower up to higher forms. So the most puzzling things of all to the old school of teleologists are the *principia* of the Darwinian.*

It is no final solution of the difficulty, and yet man, who is so wise and good that he is always saying with King Alphonso of Castile, "If God had called me to his councils things would have been in better order," has invented competitive examinations,

* "Life and Letters," i, p. 280. † "Origin," p. 428. ‡ i, p. 279.
* Asa Gray, p. 378.

which mean suffering and pain for all, without even a compensating "survival of the fittest" or improvement of the race!

To sum up thus far. One who believes in the God of Christianity is bound to believe that creation is his work from end to end, that it is a rational work and the work of a being who is wholly good. He is bound to believe that "God's mercy is over all his works," that "not a sparrow falls to the ground" without his knowledge, that there are design and purpose everywhere. But he is not bound to know or to say that he knows what that purpose is, or to show that marks of beneficence are everywhere apparent. Still less is he bound to assert, as the old teleology did, that he can demonstrate the wisdom and goodness of God from Nature alone. Evolution starts with an "act of faith," a postulate of our rational nature—viz., that everything is rational and has a meaning, even that which is at present irreducible to law. In this belief much which was once meaningless becomes intelligible, and a scientific man's faith is not staggered by the fact that much as yet remains outside, which science has not explained. On the moral side also we start with an "act of faith," a postulate of our moral nature, that God is good and can not be the cause of meaningless and unnecessary pain. And our faith is not staggered by much which seems, as yet, like useless suffering. Even if Darwin's mature judgment that on the whole "happiness decidedly prevails" were not true, we should still believe in the goodness of God, in spite of all that seems to contradict it, and look forward to the time when our children, or our children's children, will see clearly what to us is dim or dark. —*The Guardian.*

THE GEOLOGICAL TOURIST IN EUROPE.

By ALFRED C. LANE.

NINETY thousand Americans go abroad every summer. Among this army there must be many readers of this magazine, who are interested not only in art but in science; who find time to wonder, as they toil up to the top of Cologne Cathedral, what the stone is that sustains so mighty a mass, and whence come the crystals that now and again flash from the walls; who, as their eye roams over the vast expanse seen from above, let their imagination roam into the past when the Rhine had not yet won from the sea the provinces over which it now meanders. The artist finds guide-books crammed with catalogues of museums containing works of man and critical notices of the same, and man's battle-fields and burial-places are noted. Yet the collections of natural wonders are so curtly mentioned

as to be easily overlooked, while the hidden forces producing the landscape that the artist depicts, the battle-fields of Nature, and the burial-places of conquered and conqueror alike in the struggle for existence, are rarely noticed.

The proportion of scientific men that go abroad is not small. How much greater the number of amateurs! How naturally do college students pass from the attached life of lecture-room and laboratory, floating off into the free life of travel! Where better can they go than to Europe, where they can learn the languages, the keys to the various chambers of scientific knowledge, and where roads and inns are so good and abundant? Although Europe is not the pattern of the world, yet most of our geological theories have been founded on European facts, and it is easier to see where a theory does not apply after seeing where it does.

Notes of some of the more satisfactory of my excursions, arranged more or less continuously, may not be useless, therefore, especially if accompanied with a few references. I know that three years ago I would have given five dollars for such an article. Of course, my sketch must follow the line of my studies. Another would doubtless wish to give Kew Gardens, the Jardin des Plantes, and the zoölogical station at Naples more place; but if the imperfections of this article should cause some one else to satisfy the crying need of a set of scientific guides, I would be content. Even if it only leads some summer wanderer to buy a geological map or two, and see not only with the eyes but with the understanding also, it will have had reason for being.

Suppose we have escaped the illustrations of the floating-ice theory off Newfoundland, and passed across that hackneyed specimen of an ocean-current, the Gulf Stream, and are about to follow the course of the satchel-guide or some such book through Europe, with limited time.

We land first on the Emerald Isle (13).* Being a glaciated country, the casual observer will not see so much of the great basin of subcarboniferous limestone which the island is, but the bogs due to irregular deposition of drift are a characteristic feature, and we may see the *drumlin*—a word recently borrowed to denote those smoothly rounded hills of compact bowlder clay, formerly called lenticular, so common about Boston. We may also see the Giant's Causeway and Fingal's Cave, illustrations of basaltic jointing. I have from Portrush, not far off, a tephrite obtained by Prof. Carvill-Lewis.

Crossing over the channel, we will not stop to examine the beds of Anglesea, interesting as they are, unless we have plenty of time; yet, if one has it, and is interested in metamorphic rocks, a study of the ground, in connection with past literature,

* The numbers refer to the books at the end.

may help his understanding of that which is to come. If not provided with maps, etc., we had better go at once to London and provide ourselves at Stanford's. While in London we must not fail to visit the Museum of Practical Geology in Jermyn Street, which issues a number of catalogues of permanent value (33), and a geological guide to London, and contains models and collections of all kinds. Every one will admire the polished marbles, granites, and serpentines. If we have a Saturday free, an excursion of the Geologists' Association may attract us. At any rate, we shall notice that London lies in a geological basin, and, if our drinking-water is from some deep artesian well, we may thank our stars that London has such a favored situation as not to be entirely dependent for water-supply upon the filthy Thames. Let us go north. There are three main lines of tourist travel. The most westerly passes by the lake district of Westmoreland and Cumberland. It is curious to note how uniformly that combination of mountain and lake which is most attractive for summer resort occurs where a region of metamorphic rocks has been subjected to glacial action. Lake Superior and Windermere, Maine and Switzerland, all answer to this description. We dare not stop to discuss the reasons. (See 4, chapter xxvii; 10, p. 516.) We shall see the same sort of thing in the Trossachs and Switzerland. If you want to do any detailed work in the region, start in from Keswick, where a museum contains local collections and models.

Scotch surface geology is of the same glaciated type so familiar in America, and those who wish to study the parallel roads of Lochaber, or the Tertiary gabbros of Judd, must turn to the Scotch survey for guidance (3, 5, 13). For us an excursion or two about Edinburgh must suffice. The collections of the Museum of Science and Art are fine, and we can climb the volcanic crags of Castle Hill, Calton Hill, or Arthur's Seat, and wonder what the landscape was like when hot lava rolled down Salisbury crags. At Newhaven, near by, on the shore of the Firth of Forth, the clay ironstone is exposed, and, breaking open the oblong pebbles, you may find a fish, but more likely a coprolite or septarium. If you wish to see more of the Carboniferous and the coal and iron industry, you have only to run down to Gilmerton, near which are numerous coal-mines, and great piles of iron-ore a-roasting. Ganoid scales and teeth are not rare, and are collected by some workmen. The name of one was Joseph Blair, of Loamhead.

On our way south again we shall probably pass through the Peak of Derbyshire and behold the scenery of the subcarboniferous, the great mountain limestone in its most beautiful development, its dewy dells, its steep yet rounded bluffs, and its

innumerable caves. So far as caves are concerned, the formation in Kentucky surpasses it, but its veins of lead and fluor-spar —blue John as it is called—are peculiar to it.

Farther south, near Bedford, the oölites and Oxford clay are well exposed, beds not much developed in our Eastern States, and not far off, near Cambridge, the chalk comes in. The Cambridge greensand, formerly worked for phosphates, is nearly worked out, I believe, but hosts of the charming little ammonites, brachiopods, and crabs that the workings yielded, are stored in the museum, awaiting exchange. In the museum, too, you may learn where the chalk is best to be seen, and whether any recent excursion has probably cleaned the workmen out of all their good sea-urchins. They say that from Cambridge to the Ural Mountains no land rises above two hundred feet, and certainly off toward the fen-land which man has redeemed from the sea it looks plausible. What a change in the geography and politics of Europe a submergence of two hundred feet would cause!

Back once more in London, other excursions invite us (see 2, and the reports of excursions of the various Geological Societies and meetings of the British Association) to the Isle of Wight, or to the Lizard, which is, naturally enough, serpentine. But between so many it is easier to skip them all than make a choice. Let us follow the track of the Geologists' Association to Belgium (14). Reaching Brussels, we find in the Musée Royale near the picture-gallery a magnificent collection, unique in its iguanodons, and finely arranged to illustrate geological excursions. Notice, for example, the section along the Meuse, with illustrative specimens.

In the suburbs of Brussels the work of the builder is continually opening and closing sections in the tertiary sands, but somewhere surely one can see the *grès fistuleux* of the Bruxellien, whose curious columns of sandstone, consolidated around annelid tubes, stand up amid the yet unconsolidated sand. Various nummulite zones occur, but not recent information as to where to pick up these coins of Nature's realm is valueless (compare, however, 14). Shark's and skate's teeth also occur, and occasional crabs. Very close to Calevoet Station I picked up a chunk of half-consolidated sand fairly bristling with teeth. The pamphlet (14) covers the ground so well that I need not dwell on Belgian geology, except to call attention to the agricultural geological soil map (15). Nor does Holland call for particular remark, except that one should not fail to run down to Katwyk-am-Zee from Leyden, or Scheveningen from the Hague to see the mighty dune-bulwarks that protect the land from the storms of the North Sea.

Starting up the Rhine, we shall have passed out of Holland before we leave alluvial soil, and a route which has much more of geologic interest and variety, and is not devoid of beauty and historic association, is to go across the Belgian coal-fields, scenes of the worst European strikes, up the gorge of the Meuse. In passing, I note that the curious porphyroids of Bonney (14) and Renard have been recently blasted into in road-repairing, so that the next comers will have a better chance than for some years before, when the continuous attrition of geologists' hammers had rounded off every corner. At Charleville-Mezières, a typical provincial French town, we stand on the rim of the Paris basin, and *gryphæas* of the Lias abound. Thence, running along the rim of the basin past Sedan, we come to Luxemburg or Metz. Luxemburg is beautifully situated, being surrounded by cañons cut into the sandstone here so typically developed that it is called the Luxemburg sandstone. If we go to Metz, the work of fortification still going on gives good sections in the Jura. Only beware lest you are charged upon by some too vigilant sentry, as a friend of mine was. I escaped by being careful not to have maps or note-books around in sight. However, if attacked, pick up a *cidaris* club and defend yourself manfully. We can go on to Treves, into the Eifel, or down the Moselle, or to Saarbrücken, the great coal-center and first point attacked by Napoleon III, and down the Nahe to the Rhine. Whichever is omitted may also be taken as a side excursion from the Rhine.

Suppose, however, we go straight up the Rhine. We come first to Cologne. Climbing the cathedral, we see off on the south-east the seven blue summits of the Siebengebirge, whence the gray trachyte with sparkling sanidin crystals comes, that lines the winding staircase we have ascended. In the Siebengebirge is the cave of the dragon that Siegfried destroyed, and true it is, according to geologic tale, that once the volcano did cut off the mighty stream that glides in serpentine course beneath our feet. The victory was but for a time, however. Siegfried is dead, and so is the volcano, but dragons and rivers are hundred-headed and immortal, and the Nibelungen gold is still guarded securely. To the Siebengebirge, then, will be our next excursion, and we had best start from Bonn, the famous university town. We can there buy what guides we wish (16), and visit the collections of the Poppelsdorfer Schloss, valuable and beautiful themselves, and especially to us, as they illustrate by models and specimens what we are to see. Some of the rooms are fantastically decorated with bits of satin-spar and shells. Sturz's natural history store, one of the finest and largest—but not the cheapest—in the world, is in Bonn. His polyglot catalogue gives many hints for excursions to the collector.

Along here Baedeker has an unusual amount of geologic notes, and so we pass rapidly on, noting casually the imprints of leaves in the trass of the Brohlthal, and the Laacher See, latest worked upon by an American, L. L. Hubbard. At last we reach Coblentz, from which one division of the Devonian, through which we are passing across the strike, takes its name. Here the valley of the Moselle invites us to take a *détour* into the district of little extinct volcanoes called the Eifel. This is one of the standard geological excursions (16), and in the Whitsuntide vacation of 1886 there met in Gerolstein no less than thirty-five geologists, representing five different German universities, and I dare not guess how many nationalities.

The little inns that are sprinkled through the district are generally good, and well up on the customary mineral localities. This is one of the great regions for volcanic minerals, augite, hornblende, sanidin, olivin, apatite, sodalite, etc. In the neighborhood of Gerolstein abundant Devonian fossils are collected, calceola, gomphoceras, trilobites, and corals. At Gerolstein itself is a dealer in such things at reasonable prices (except for the trilobites). This village is prettily situated, and rejoices in an open fountain of soda-water. These are, in fact, common in the Eifel, the Apollinaris being the most famous, but many others, as Birresborn, are as good. Over against Gerolstein lies a bluff crowned with a massive limestone, once the bottom of a synclinal fold, which reminds one of the text of Isaiah, "Every valley shall be exalted." On our excursion we spent the first night in Wittlich; the village is not near the station, for Continental stations have a way of splitting the difference between two towns which must be well borne in mind by the walker. The next morning we rode on to the Mosenberg, an extinct volcano that has three crater rings very distinct. Coming down, after a *détour* to the Meerfelder Maar that I do not recommend (the meat at the inn was little, but lively), we went on to Manderscheid. Here we had a good dinner at the Hotel Zeus. No doubt our whetted appetites added sauce, but those trout were certainly good.

I know of no spot on earth so romantic as the situation of the twin-castles of Manderscheid. A stream flows in a huge S about two ridges of rock, on which the castles are built, so narrow in places that one could hold a thousand in check. Out along one of these rocks, then steeply down and up—a rough scramble not suited for skirts—we went to Gillenfeld, passing a couple more crater-lakes on the way. Here we stopped the second night. The inn was full, so that I went out to the "pastor's" to sleep. The next morning, in spite of lowering and later pouring weather, we took a *détour* to the Pulver Maar, another lake with-

out an outlet, where sanidin bombs may reward the seeker, and bits of underlying Devonian slate are strewn through the strata of volcanic ash. Returning to Gillenfeld, we had a little something to eat and drink—the Germans never neglect the inner man—and went on past its crater-lakes to Daur, where we dined at Hotel Hommes. On the card of this inn is a sketch-map of the Eifel, and a geological map and minerals are about the house. While waiting for dinner we picked up a lot of augite crystals from the locality near by. After dinner we hired a dray-cart and pushed on to Dreis, arriving there late, to spend the third night. The next morning, after collecting basaltic hornblende east of the town, in crystals up to the size of an egg, mostly rounded a little by fusion, and taking also some of the olivine bombs, of which so many are scattered through the museums, we went rather across country to Gerolstein. There is much of interest on the way, first petrographic, afterward more paleontologic.

From Gerolstein various further excursions can be made. A visit to the ice-cave of Roth is refreshing in the heat of summer. But the summer tourist must not tarry. So on to Treves, and down the Moselle and up the Rhine, till passing through the ridge of Taunus we emerge into the upper plain of the Rhine at Bingen. From Bingen a side excursion to Münster-am-Stein, if no farther, is of great interest and beauty (17), and those who are attracted by the silver sheen of tiger-eye, the peacock hues of labradorite, or the delicate tracery of moss-agate, should not give Oberstein the go-by. Here, and near by, the semi-precious stones are polished for all Europe, and from Heinrich J. Steffen can be obtained specimens of the melaphyres in whose cavities agates are wont to come, and of the fossils of the region—trilobites and ophiuroids. The view from the station of town and river, and above two castles and a church curiously let into the rock, is said to be one of the three finest on the Rhenish railways.

Near Kreuznach I may mention Hackenheim churchyard and a little southeast as a place where fossils of the Mayence basin abound, and the valley from Kreuznach to Winterburg and back over the Welschberg, with its patch of Tertiary to Bockelheim, as giving a good section of the country. If you want to see more of the Mayence basin, a good way will be to seek the tall chimneys of the cement-factories and the neighboring limestone and clay-pits—e. g., those of Wiesenau. From this region immense quantities of cement are exported to America. The two sides of the great Rhine Valley, which has till recently been considered a typical case of dropping in, are not unlike. Most people go down the east side, and we will follow them. The Taunus region has some interesting porphyroids and sericite

rocks. Next comes the Odenwald. The northern part of this has not been recently described (18) as a whole, although there is much of petrographic interest. The Rothliegendes, with its amygdaloids, is broken through by basalt, which at the Rossberg has glass inclosures, at the Oetzberg sandstone inclosures. In Darmstadt is a museum, which may be of assistance. South of Darmstadt, around Castle Frankenstein, is a mass of gabbro and diorite with many interesting varieties. Near Auerbach marble occurs, and in sundry other places garnet rocks.

We now are approaching Heidelberg, a town well placed as a center for geologic excursions. Benecke and Cohen (19) have, however, one fault as guides. They are too complete; so that a few remarks may not be out of place. North of Heidelberg the petrographer will find much and the paleontologist nothing, for the well-known Triassic sandstone and the Rothliegendes are not fossiliferous. South of Heidelberg, however, past the cadmium and zinc mines of Wiesloch, we can get a continuous section through the whole Trias well up into the Jura. Lime-pits and cement-works quarries afford exposures into the weaker beds, and the workmen have learned to save the ammonites, etc. East of Heidelberg, following up the beautiful valley of the Neckar, we come to the nephelinite of the Katzenbuckel, a stone in places so coarse as to yield when weathered distinct crystals of nepheline.

In the Friedrichsbau of the old university is an interesting collection of maps, models, and specimens. There is also a school of petrography much frequented by students of all nations, especially Americans. On the steep way up to the castle from the Prinz Carl Hotel is the natural curiosity store of Blatz, the oldest house in Germany, I believe, with very reasonable prices. The granite on which the castle stands is best exposed on the Valerien-Weg, a pretty path just beyond the Carlsthor. Leaving the valley of the Neckar, the hills gradually grow lower and more rounded till near Baden we approach the Black Forest through which the Black Forest Railway winds its bold and tortuous way. Geologically this is essentially like the Odenwald, and Eck's inexpensive maps (20) will serve as guides. I should not pass Strasburg and Freiburg without mention. The one, with a university, fine collections, and a geological survey, is the natural center for excursions in Alsace—not so pleasant just now, for geology has less regard for frontiers than have the French and Germans. The other has also university collections, and may be made the center for excursions in the Black Forest or to the Kaiserstuhl, an isolated volcanic peak rising out of the Rhine, and a locality for limburgite, perowskite, and zeolitic minerals. It is mostly cultivated in those oblong patches characteristic of peasant proprietorship.

Switzerland is now our goal, but when should I leave off if I began describing? There the guide-book must perforce pay attention to the works of God that tower so stupendously above those of man. There is even an old scientific guide to Switzerland (31). But while leaving you mainly to the books (2, 3, 6, 10, 12, 21, 22, 31), I may properly emphasize the enormous folding that the rocks have suffered, till gneiss and limestone are intercalated (10), the gradual rise of the chain on the north, and relatively sudden drop-off facing the great plain of Lombardy. The land-slips around the lake of Zug have attracted recent attention, and the origin of the Swiss lakes has already been referred to. The main scientific centers and collections are at Zurich, Berne (where the great smoky quartz crystals are), and Geneva.

Let us still keep south. In the Odenwald, Black Forest, and Taunus, we had seen the old age of mountains, their teeth worn down to stumps; in the Alps we have seen their manhood, the sharp "dents" piercing the sky. In the Apennines we shall find them in youth just cutting their teeth, with gums still bleeding lava. But as you reach Turin, climb over the huge mass of Miocene gravel to the Superga, and cast one long look back. Fear not, for yonder snowy breaker towering high in the north has towered there for generations, and the plain of Lombardy still smiles as green as ever. Finally, we turn our backs to the glorious vision and press on through hills growing ever steeper, sharper, through rocks more and more crystalline, till suddenly the bay of Genoa bursts on our view. At Genoa the university is housed in a grand old palace, but the collections are huddled together. The civic museum is better. A couple of miles west of Genoa, north of Sestri Ponente, are some gabbros and serpentines over which is still a lively discussion. All along the coast of the Riviera we are among rocks that are not old but much disturbed, and contain numerous injections of cupriferous serpentine.

Past Carrara we go—a side-trip expensive and not very rewarding; the snow-white quarries can be seen from the train—and on to Pisa. The collection of the university here boasts the finest cinnabar crystal in the world. It comes from Elba. This interesting island (24*) and Corsica are conveniently reached from Leghorn. A little farther down the coast branches off the line to Saline. This is a pleasant side-trip to one acquainted with Italian. North of Saline is Monte Catini, with copper-mines and a unique mica trachyte—used for mile-posts, and by the Etruscans for carving. Over the gate of Volterra near by is a head of unknown antiquity. Volterra is the center of the alabaster industry, and a gypsum formation crops out frequently

in the neighborhood. Not far off to the south are the borax springs that supply Europe, the nearest being at Monte Arboli. Returning to the main line a little farther south is San Vincenzo, where a cordierite trachyte occurs, and in the works for lead and zinc near by toward Campiglia fine specimens of botryoidal bustamite are to be found.

Soon another line goes off to our left to Monte Amiata, an extinct volcano, whose lava contains interesting glass balls. It has recently been thoroughly described by an American, J. F. Williams ("Neues Jahrbuch," 1887). Half-way from here to Rome the volcanic tufa of the Campagna (25) comes in, and soon we are in sight of St. Peter's. There are collections in the university, but more modern ones at the rooms of the "Comitato Geologico," not very far from the railway-station in the modern quarter. On the Campagna the Roman cement—pozzuolana—diggings should be noticed, and we should go far enough on the Appian Way to visit the quarries in the melilith basalt of the Capo di Bove, whose cavities abound in tiny crystals of melilith, apatite, nepheline, etc. Monte Mario is well known for Pliocene fossils, and from Tivoli comes the famous travertine building-stone of Rome. The region of the Alban Lake affords pretty excursions. The workmen have leucite crystals.

Lago Bolsena is interesting but hard to get at. So on to Naples, where an Englishman, Dr. Lavis, is the present authority (23) on Vesuvius and Monte Somma, and has a fine collection. We should not fail to notice that east of Naples is another volcanic district, in type, time, and products of eruption quite distinct from Vesuvius, the Phlegræan fields, the front garden of the infernal regions, according to Virgil.

Armed with a permit from the palace at Naples, we visit the beautiful park crater of Astroni. The way leads past the famous Grotto del Cane, along the Lago d'Agnano, once a lake, now drained. On the road to Pozzuoli, where the Serapeum has had literally so many ups and downs, is the Solfatara, another smaller but livelier crater. A steam-tramway also connects Pozzuoli and Naples, and this may be made the starting-point of a second excursion among further craters, Lake Avernus, etc., which should certainly include a climb up Monte Nuovo, newest of mountains. May you be more fortunate than I, and have a chance to go farther and visit Etna and Sicily! But most of us must now return. Before we leave, one last warning: don't lay out too much for a day's work near Naples. Water is scarce and bad, wine is not good for walkers, and the climate is relaxing.

On the way back from Rome we will follow the central trough of the Arno and Tiber, which, near the water-shed where the water was dubious which way to go, was for a long time very

marshy, but has been in this century greatly improved by a process of controlling the mountain-streams and making them deposit their detritus so as to increase the grade. Notice on the west side how the layer of tufa overlying Pliocene sands resists erosion and makes flat-capped, naturally-walled hills. The site of Orvieto is a good example. In Florence are also collections, but the Tuscan Exposition of 1887 will probably have altered their arrangement.

At Prato, a little north of Florence, famous for vanilla-drops and a bronze screen, we may leave the train and walk a few miles to Monte Ferrato, where there are quarries of a beautiful gabbro, pietra verde, much used for decoration. It is surrounded by serpentine and porcelanized slate. At the Cave del Acqua it is most coarse and fresh. Soon after we turn sharply and cross the Apennines over to Bologna (3, 23). As from Turin to Genoa, so here—the whole range is Tertiary and the same horizons which in Belgium we saw hardly disturbed since their deposition, are here highly metamorphosed. The University of Bologna has a fine, well-ordered collection, especially to be visited by those who will tarry a little in the Euganeans, where Petrarch was born (10). Thus they will get an idea of the peculiar volcanic products awaiting them. There are still hot baths at Battaglia.

Every one will notice the Holland-like character of the country about Ferrara, and the way the Po flows along with its bed above the adjacent fields, over pebbles from the Alps far away, and will wonder how long it will be before the lagoons about Venice will in their turn become fertile plains. We have been around Italy. We may now go *via* Verona—don't pay the awful prices the man at the amphitheatre asks for his fossils—and Trent up into the Tyrol. The Tyrol and Switzerland are geographically but not geologically divided, so I need add only a reference to the work of Von Buch on the dolomites (10), and that of the Austrian geologists (12*). In Innsbruck is a very full geognostic collection.

We may go hence to Munich, where Groth's new laboratory affords every luxury to the mineralogist and petrographer, and Zittel conducts the most famous school of paleontology in the world, and Gumbel directs the Bavarian survey (3). Or the route to Vienna, by way of the Salzkammergut, is interesting, and the city is a focus of scientific interest, with a magnificent university.

Farther east the casual tourist will scarcely go, although no country of Europe surpasses Hungary in geological interest, where there are several important mining centers. I have been as far as Constantinople, with no extra trouble except that

caused by the numerous dialects. The Austrian geologists are fully abreast with the times.

But, turning from Vienna northwest, we come into Bohemia, the scene of Barrande's great labors. Its mineral springs (28), of which Carlsbad, whence the twinned orthoclase, is the most famous, and Marienbad the best tasting; its coal-basin, its phonolites (that of Neuhof shows the nepheline to the naked eye), and basalts and porphyries, are all noteworthy (35). The rocks near Marienbad have been recently described by H. B. Patton. In this region, too, is a place that should stir the soul of every American, Joachimsthal, the birthplace of the dollar, i. e., thaler. The silver-mines are still carried on in a picayune sort of way, largely for fancy ores, uranium, etc.; but by their gradual exhaustion the population is being driven into the manufacture of Bohemian lace and kid gloves. Bohemian garnets are too well known to need mention.

Passing north, we will follow the valley of the Elbe, which has cut its way through the massive Quader sandstone, leaving it in plateaus or isolated towers, affording the finest specimen of cañon scenery known to me in Europe. The way is lined with quarries, for the cream-colored sandstone is extensively used for building in Dresden and elsewhere, and takes the place of the Bunt or new red sandstone in the region of the Rhine. Not far from Dresden, in Plauen, are large quarries in the rock that is the German type of syenite, and is supposed to have no quartz.

Thence we may go on to Leipsic, the seat of the famous university and of the Saxon survey (3 and 29). Zirkel and Credner are located here. The black pyroxenic quartz porphyry of Kleinsteinberg, close by, has attracted much attention. We are now on the edge of the great plain of North Germany, with nothing but sands washed by glacial drift from Scandinavia to the north of us, except where the Harz (the kingdom of Prof. Lossen) rises like an island (30*). On the way is Stassfurt, whose mines are a chemical storehouse for the world.

There are, of course, other points of great interest in Germany—Freiberg, in Saxony, the star of whose mining-school has passed the zenith. Those who make a pilgrimage to Baireuth are among fossiliferous beds (Allersdorff), and not far from the Fichtelgebirge. The Solenhofen lithographic stone and its fossils are unique, but geologic attention has not been recently concentrated on Würtemberg (26 and 27). We have not yet visited Norway, Russia, Spain, or France. Through the latter country Meunier will guide us (31*, 32, 6). In Paris we must part company, after, I hope, a pleasant tour. Don't fail to visit the Sorbonne and the Jardin des Plantes. All the lectures are public, and the Jardin des Plantes has also fine general collections.

BOOKS AND MAPS SERVICEABLE.

General Topographic Maps.—Baedeker's guides are best in this respect, for Rhine and Alps sufficient. Every nation has military maps covering more or less of Europe. The Austrian map covers most of Europe, and is good.

(1) See the Preis-Verzeichniss of R. Lechner in Vienna (Wien). Also—

(2) Stanford's Tourist Catalogue, 1884, with addenda and corrigenda since (gratis). This firm's specialty is geologic and geographic publications. The guide to the Isle of Wight by M. W. Norman, 1887, may not be catalogued yet.

(3) For geologic maps see National Geological Surveys of Europe, by William Topley (6*d.*), 1885, London, Trübner & Co.

Note that the official surveys are not always strictly confined within boundary-lines. So the Austrians have done much work in the Balkans, and the earlier French survey of De Beaumont covers one's route up to Italy or the Tyrol. Many of the books and geologic guides mentioned below include or accompany maps. Such are starred. Of bulky works on European geology the following are the best:

(4*) Ramsay, Physical Geology and Geography of Great Britain (11*s.* 6*d.*), 1878, E. Stanford, London. Just out is Woodward's Geology of England and Wales, 1887, 18*s.*

(5*) Geikie, A., Text-Book of Geology, 1882.

(6) De Lapparent, Traité de Géologie, 1885, F. Savy, Paris. (The last seven hundred pages contain a full account of the formations in various countries, with references.)

(7) Mourlon, Géologie de la Belgique, 1881, F. Savy, Paris. (Purely local.)

(8) Credner, H., Elemente der Geologie, 1883, Leipsic, Engelmann.

(9) Roth, J., Allgemeine und chemische Geologie, 1879–1883, W. Herz, Berlin. (The second volume, just complete, is full of petrographic localities and references.)

(10) M. Neumayr, Erdgeschichte (16 marks), 1886, Bibliog. Institut, Leipsic. Very fresh and finely illustrated.

(11) Suess, Das Antlitz der Erde.

(12*) Von Hauer, F., Geologie (as applied to Austria), 1878, A. Hölder, Vienna (Wien).

Of smaller transportable works may be mentioned the following:

(13*) Geikie, Outlines of the Geology of the British Isles (2*s.*), 1876, W. & A. K. Johnston, Edinburgh.

(14) Geology of Belgium and the French Ardennes (1*s.* 6*d.*), 1885, Stanford, London. (By various writers; includes rough sketch-map and references to Dewalque's map, etc.).

A joint excursion in the environs of Brussels was made by the Geologic and Malacologic Societies, reported by A. Rutot, 1881. A separate reprint of this would be the best guide. Such reprints are valuable guides, and are often advertised in catalogues of second-hand books, or may also often be obtained of the secretaries of the various societies or the authors.

(15*) The agricultural geology of Belgium, sketched in 14, is treated more fully by Malaise and De Laveleye.

(16*) On the geology of the Rhine (Baedeker has something), Von Dechen has a series of Geognostische Führer in das Siebengebirge, Vorder-Eifel, Hinter-Eifel, etc. In society proceedings, various papers by Wolff, Hubbard, Laspeyres, etc.

(17) Führer für Besucher des Nahethal, 1884, Voigtländer, Kreuznach, has geologic and botanic appendices.

The work of the Prussian Survey of Weiss and Laspeyres, and the Flötzkarte of Saarbrücken may be noticed.

(18*) Ludwig, R., published a Geologische Skizze, to go with the map of Hesse (see 3), out of print now. There is a new survey by Lepsius in course of publication.

(19*) Geognostische Beschreibung der Umgebung von Heidelberg, Benecke & Cohen, 1877.

(20*) Eck, H., has issued a series of good maps on the Black Forest, the Black Forest Railway and environs, Renchbäder, Ottenhofer, etc., very much detailed, poorly printed, and cheap in price; 1885-'87, Lahr.

(21) Heim, A., is the great authority on the structure of the Alps, folds, faults, etc. His results are given, however, in (6), (8), and especially (10). Tyndall and Agassiz are mentioned, *honoris causâ*, on glaciers.

(22*) Stapf, Geological Map of the Saint Gothard Railroad from Erstfeld to Arbedo, 1:25,000. Practically covers the whole crystalline belt.

(23) Italy has been traversed by so many that the geological literature is wide-strewn. A bibliography was published in 1881 for the International Geological Congress at Bologna. J. Roth's Vesuv. and Lavia, in the "Quarterly Journal of the Geological Society," London, are up to date.

(24*) Lotti, B., Desc. Geol. del Isola Elba, 1886.

(25) Carta Geol. della Campagna Romana, 1880, Roma.

For the Tyrol the Italian part of the Austrian publications should be noted. Guides to collections often have a wider usefulness. Among such pre-eminent are those for Berlin and Strasburg.

(26*) For Würtemberg, besides the old Geognostische Verhältnisse, by Hehl (1 mark), 1850, Schweizerbart, Stuttgart, is the newer—

(27) Die geognostische Sammlungen Würtembergs, by Oscar Fraas (0·50 mark), third edition just out, Schweizerbart, Stuttgart.

(28) Laube, G., Geologische Excurs. im Thermalgebirte des N.W. Böhmens, 1884, Leipsic. Among other workers in the same field in journals are Reuss, Boricky, Becke, and Patton.

(29*) Credner, H., Geologischer Führer durch das sächsische Granulitgebirge, 1880, W. Engelmann, Leipsic. There is also a fuller "Beschreibung" by the same author.

(30*) Lossen, K. A., has published a very thorough map of the Harz, which is expensive. The literature is mostly published by the Prussian Survey. See (3), as also for Bavaria.

(31) Meunier, S., Excursions géologiques à travers la France, 1882, G. Masson, Paris. (Chatty; includes Belgium and part of Switzerland.)

The smaller French school-books, e. g.—

(32*) Von Raulin, Éléments de Géologie, are very local, and handy to the pocket.

(33) Catalogues to porcelain manufacture, to geologic models, to rock specimens, fossils, mineral collections, mining records, and guide to geology of London (prices 3*s.*, 2*s.* 6*d.*, 2*s.*, 2*s.*, 4*s.* 6*d.*, and 1*s.*), Museum of Practical Geology, Jermyn Street.

(34) Scientific Guide to Switzerland, Morrell. I have not tested it by experience.

(35) Hibsch gives the literature of northwestern Bohemia in Tschermak's Min. and petr., Mittheilungen, 1887, Wien, Alfred Holden.

EDUCATION AND THE EMPLOYMENT OF CHILDREN.

By ELIZA F. ANDREWS.

FOR years the world has been on a moral crusade against the employment of children in mines and factories, while the far greater evils that result from the mothers going out as wage-earners have attracted comparatively little attention. Labor, within certain limits, is good for the child, giving it a wholesome moral discipline, and training it for the business by which it is to earn its livelihood; but, when a married woman has to neglect her natural duties for the responsibilities that properly belong to the other sex, it is time for humanity to protest in the name of her offspring. No one individual can fulfill satisfactorily the double or, I should say, the triple function of bearing and rearing children, and providing for their maintenance. I am a laboring woman myself, and have met with some success as a bread-winner; and I know that the conditions of performing this function satisfactorily are quite incompatible with those arduous and important duties which make such heavy demands upon every conscientious mother, especially among the poor. In the homes of the very poor there are no hired servants to keep the household machinery running smoothly while the mistress is away. The wife of the laboring man is frequently cook, nurse, house-maid, laundress, all in one; and if she must go out as a bread-winner besides, what is to prevent the domestic engine from running off the track and getting itself hopelessly ditched?

Of the two evils, if both are evils, I am persuaded that it is better that the child should go out to labor than the mother. Liberty, uncurbed by the check-rein of parental restraint, is a more than doubtful blessing, for the loss of which the child that takes its mother's place in the shop or the mill is more than compensated by the advantage of having her care at home. It is of far greater importance to the physical and moral well-being of the child that it should have a clean, well-ordered home to receive it out of working-hours, than that its working-hours should be abolished. The real hardship to the children of the poor lies not in setting them early to learn the wholesome lesson of labor, but in leaving them to grow up amid the discomforts and dangers of a neglected home, while the mother is bestowing upon loom and spindle the care that is the natural birthright of her little ones.

But here we are confronted with the question of education, and it will be asked, How is the child ever to learn anything if put to work so early? Such considerations, however, need present

no real difficulty, if we could once rid ourselves of those narrow views of education which bound it by the walls of the school-room, and can see no way of learning anything except by getting it out of a book. Education, in the proper sense of the word, is that course of training which will best fit an individual for the business of life, or, to speak more accurately, will best enable him to adjust himself in harmony with his environment. The kind of education that is best for any person will depend, therefore, very much upon what his environment is to be; and as it certainly can not be maintained that the environment of the majority of mankind is such as to require a very great amount of book-learning, it may reasonably be asked whether some of our popular theories of education do not need remodeling. By this I do not mean that our facilities for higher education should be in any way diminished, but only that we should use a little more discrimination in applying them, and bestow the highest advantages where they are likely to do most good. Many well-meaning teachers labor under the idea that they must spend their best energies upon dull pupils, and go on for years throwing away their time in trying to accomplish what the homely wisdom of our fathers has pronounced the impossible task of making a "silk purse out of a sow's ear." Trim your sow's ear, clean it and comb it and make as decent and reputable a sow's ear out of it as you can, by all means, but don't put your gold and pearls into it, under the belief that it is a silk purse. As our Georgia farmers say, put your guano on your best land, and you will get a paying crop.

Each department of the world's work can be best carried on by those who are fitted for it. The intellectual work, like every other, can be carried on with success only by those who have some capacity for it, and, by bestowing an elaborate intellectual training upon all alike, without regard to natural qualifications, we damage both the state and the individual: the state, by wasting its resources in unremunerative intellectual products; the individual, by leading him into fields where he is forced into competition with those better equipped for the struggle for existence, and against whom, by the inexorable law of the "survival of the fittest," he has no chance to contend with success.

Where people have money to pay for the education of their children, there is, of course, no remedy; and in our private schools and colleges we may expect always to see rich blockheads grinding through the process of what they call getting an education; but where the state pays the cost it has a right to see that its money is spent so as to secure the greatest benefit to all concerned. This can be done by a rigid system of grading, each school being a stepping-stone to the next higher. Let a

certain standard of scholarship be required in each grade as a condition of entering the next higher, and let all who do not come up to this standard pass out to the factory, the workshop, the plow, the wheel, the lathe—to whatever, in fact, is to be their life's work. The requirements in the lower grades should not be too high, and every one should have an opportunity of learning to spell, read, and write, with something of the four cardinal rules of arithmetic; but after that the standard should be rapidly raised, so as to weed out all but the best material before reaching the high-school, and thus avoid the great economic mistake of turning into poor scholars material that might have made good artisans and mechanics.

Under such a system, the weary mass of juvenile mediocrity that cumbers our high-schools and keeps down their standard of scholarship would be switched off early on the right track; for, since the vast majority of the human race must live by the work of their hands, it is quite as important that the hands should be educated as the head. Schools of technology are needed for such of this class as may be destined to callings requiring special skill, such as architecture, joinery, engraving, and the like; but, for the rank and file of hand-workers, I question whether the mill and the workshop are not the best schools. To many they are the only available ones, for the families of the very poor can ill afford to sustain non-producers, and to them it is essential that the labor of every member should be directly remunerative.

If we take this broader view of education, there is no reason why its claims should conflict with the humane employment of children in work suited to their strength, at a comparatively early age, and there are cases where the enactment of laws against it would be a positive cruelty to the children themselves. Especially is this true where keeping them at home would necessitate the mother's going out to labor. Unmarried females can work as bread-winners without detriment to themselves or to society; and the ever-increasing band of "superfluous" women, which is so significant a feature of our advancing civilization, is quite sufficient to supply all demands for female labor without calling mothers away from their natural post of duty.

It is not a matter of mere sentiment to reserve the mother's time and labor for her children, but of sound political economy. There is no question of greater importance to the state than the training of its future citizens; and a home where thrift, cleanliness, and good government prevail, with that moderate amount of domestic comfort which the hand of a tidy woman can impart to even the most meager surroundings, is a more powerful factor in the production of a good education than all the schools in Christendom. I have often been struck, in the school-room, with

the vast difference that exists between well-mothered children and those poor little Ishmaelites who, through want of either time or capacity on the part of the mother, are left to scramble along the path of life as best they may. The teachers, with all our books and methods, can not lead a child even to speak correctly, when it hears nothing but bad English at home; how, then, can our endeavors, temporary and intermittent as they must be, counteract the demoralizing influence of the shiftlessness and disorder that prevail in a home from which the mother is always absent? It is beside the mark to object that the mothers themselves are often so ignorant and thriftless as to make their presence little to be desired in any home; can we expect to find models of the domestic virtues among those who have never had the opportunity to practice them? We all know that there are foolish and incompetent mothers in every walk of life; but would any one, therefore, argue that it is good for children in general to be deprived of the care of their mothers? Such faults of the poor as arise from lack of opportunity we may hope to correct; those that are inherent in human nature I leave to the moralist, as beyond the scope of this paper.

THE ISLAND OF NIAS AND ITS PEOPLE.

By H. SUNDERMANN, Missionary.

THE island of Nias is situated in the first degree of north latitude, and between the ninety-seventh and ninety-eighth degrees of east longitude, and is the largest of the chain of islands that stretch along the west coast of Sumatra. It is about seventy miles from Sumatra, and is about seventy-five miles long and from eighteen to twenty-five wide. It consists almost entirely of hill-land, through which road-making is difficult, and this, with the thick, tall grass rendering the narrow native paths invisible except almost at the traveler's very feet, makes communication difficult. Animal and vegetable life are sparsely represented. There are no dangerous animals except crocodiles and wild swine, which last are very destructive to the cultivated fields. The only domestic animals are swine, hunting-dogs, cats, hens, and a few goats. The timber-trees, in considerable variety, furnish good building-woods; the cocoa and durian are the principal foods. Sago and sugar palms, rice, yams, caladima, pisang, a sort of spinach, and a small bean, are the principal cultivated plants.

The people call themselves "Niha," which signifies "men," and their island "Taño Niha," the land of men. No definite ac-

counts exist of their origin. Some say that their ancestors came down from the sky. Another account traces their descent from the daughter of a Batta chief of Sumatra, who, having been expelled from her home for unchastity, was set adrift in a canoe, landed in Nias, and had children by a son who was born to her there. They themselves believe that they are descended from several ancestors who settled at different places on the island, and originated the various tribes into which the people are divided. They may be supposed to number about three hundred thousand. They are of medium stature, are easily tired out, and are not unlike the Malays in physiognomy. Their costume is primitive, and consists, for the men, of a strip of cloth wound around the loins and between the thighs, and so girt as to leave the ends hanging low down in front; for the women, of a square cloth, ornamented on the lower border, wrapped around the hips so as to constitute a short petticoat open at one side. In addition, the men sometimes wear a kerchief, jacket, and belt of cloth or leather, and, on festive occasions, a *sarong* thrown over their shoulders. The women, when they would be more fully dressed, wear a jacket and a *slendang*, or long cloth thrown over the shoulders, and carry a brass-mounted staff with a leaden head; while their hair is done up with brass, silver, or golden pins, and encircled with a brass or pearl-embroidered fillet. The most conspicuous of the golden ornaments is the crown, a conical framework structure fitted to the head, and adorned with golden leaves stamped with a human face, miniature palm-trees, and other curious decorations. The weapons consist of a lance, a knife or sword, and a shield; armor of overlying thick jackets or coats of buffalo-hide, and helmets woven out of palm-leaf or cocoanut fibers. A few possess old rusty guns or small cannon for festive occasions, but the introduction of fire-arms is forbidden by the Dutch Government. Their beds are mats, their pillows blocks; and for dishes they have porcelain-ware or pisang-leaves, which do not have to be washed. The housekeeping outfit also includes pork-trays, scales for weighing pork, and a smaller balance for gold, a cupboard made of hollowed logs, the rice-stamping apparatus, earthen cooking-pots and wooden troughs, and, for tools, knives, a primitive hatchet, a chisel, a file for the teeth, and a smith's stand. The houses stand about six feet above the ground, on posts which are set upon stones, a style of building which prevails without respect to situation; for it serves a good turn for defensive purposes, and affords room for the pig-pens beneath. The shape is oval, and the palm-thatched roof is very steep, and ridged instead of pointed. The entrance opens into the principal apartment, which occupies a middle position, with rooms at either end; and all the rooms

contain fireplaces—boxes filled with earth—and secret exits for escape in case of attack.

The language is difficult, but I have not found it poor in conceptions, and have met no formidable difficulties in translating the Gospels into it. It has no literature, and has only recently been written. Myths, parables, proverbs, riddles, the wisdom of ancestors, and the recitations at the dances, are all transmitted orally, and are thereby current in many versions.

The people are of childlike simplicity, careless, often sportive, dreadfully given to falsehood, and unconquerably averse to saving or making any provision for the future. Not even the desire of getting a wife, who has to be paid for, will induce a young man to save; he would rather borrow of a chief, and so put himself under obligations which are almost sure to be equivalent to servitude. The chief occupation of the Niha appears to be idling away the time. What little work is done with any regularity is chiefly performed by the women, who have to take care of the swine and look after the food.

While the special time for contracting loans is a month after the harvest, borrowing goes on all the year round. If the debtor can not pay at the maturity of his loan, the creditor acquires the right of making himself at home in his house, and demanding and receiving the best until he is paid. A similar privilege is accorded to guests, who are entertained with great show of hospitality, and are very apt to make the most of it, in complete indifference to the comfort and feelings of the family.

While the island is nominally under the rule of the Dutch, it is in fact under the control of a set of Liliputian chiefs, who are quite independent of one another, but have the most exalted idea of their magnificent importance. Their title, *balęozoe*, which may also be acquired by any one who gives a grand feast, is often adorned by some supplementary epithet, like "the foundation of the earth," "higher than the comb" (of a cock), "who is nothing else than fire," "who is always above," or "who is higher than the Malays." No real connection exists between the different clans. Head-hunting is very much in vogue in the interior; but in the northern part of the island an occasional bleached skull, suspended from a post, is the only reminder that it once existed. Severed heads, where the custom still prevails, must be had on a variety of occasions, as on the burial of a chief or the foundation of a house. One of the peaceful tribes whom I visited in company with Controller Mansveld, in January, 1877, complained of the losses they had suffered from a more warlike neighboring tribe. One local chief had lost twelve of his people in six months, another eleven, and another ten, including women and children; and another exclaimed that the tribe was in danger of

being exterminated. The murderers are hired, and put their own heads or those of their children in pledge when they go out on their expeditions, to be forfeited in case they bring in no strange head. The food of the departing head-hunter is set in the pig-trough, as if to say that he is no better than swine or a dog if he comes back empty. If they return, bringing one or more heads, they are feasted in grand style; but if they have nothing, themselves or their children are slain.

The village chieflets nominally stand in a kind of patriarchal relation to their people, for they are all more or less directly or distantly related to one another. Hence they are usually spoken of as father by the older people, and grandfather by the younger. But the chief function of this patriarchal relation appears to be the exaction of exorbitant interest and hard terms for loans. The thoughts of the chiefs are turned to the accumulation of gold ornaments and to making a great name for themselves. With an eye to the latter object, they plant large stones in front of their houses—male stones, long and slim and set upright, and female stones, broad and flat, and laid at the feet of the former, either being sometimes hewn to the shape of the human figure. The institution of the stones, or the acquisition of a valuable ornament, is celebrated by a great feast, at which hecatombs of swine are slaughtered, the people, especially married persons, being expected to contribute portions of the pork. Every chief who desires to be of consequence must give such a feast once at least in his life; and then he gets a new name, corresponding with the additional luster with which he imagines his fame has been invested.

Women are in low estate, under the pressure of a kind of polygamy. Mourning for the loss of a wife is eclipsed by lamentations for the money she has cost the widowed husband. To the husband, the wife is "the one who does his work," or "who takes care of his food." If she does not suit him, instead of getting a divorce he takes another wife and makes the former one a slave, with a regret that he had paid so high a price for her. If the husband dies, his brother or father takes his wife; for it would be a pity to let the value she represents go out of the family, and a widow will not bring more than half as much in the outside matrimonial market as a young girl. The son takes the wife left by his father, provided she is not his own mother. Children grow up like the grass and weeds, without discipline. Parents love them too much to punish them, and limit their training to empty scoldings. The family feeling is very strong, and is hardly lessened after the members have grown up to maturity and married. Assaults upon women, even of the most trifling and indifferent character, are punished by fines. Illegiti-

mate children are put into a sack, with an egg and a stick of sugar-cane, and hung on a limb to starve. Murders are avenged in blood by the friends of the victim, or the crime is brought before the chief and punished with a fine, of which the relatives receive a part. In case this is not acceptable to them, they proceed to exercise justice according to their own views.

Thefts are punished by death or fine. If the thief is not found, a curse is issued against him, by, for instance, burning a dog alive and invoking a similar fate upon the guilty man. Ordeals are employed for the detection of thefts—as the ordeal of water; or a hen's head is cut off, and notice is taken of the person toward whom the decapitated fowl flies. The resumption of friendly relations after disagreement is sealed by the imprecation of a terrible curse upon the party who shall renew the quarrel. The parties and their friends in succession take in hand a palm-leaf which is supposed to represent the person upon whom the curse is destined to fall, present it before the ancestral figures, and say, "If any malice is left in N. N.'s heart, if he seeks to do harm to the other, then twist his neck, O image of my father, image of my grandfather!"

When a child is born, the father and mother must refrain from doing anything that can possibly suggest evil, lest it fall upon the child. They must not slay any beast, they must not eat of a pig that has died (to which otherwise they are not averse), they must not pass by where a man or an animal has been killed, or make an idol or a water-trough, or blow a bellows, or burn a field, or heat iron, or take a knife in hand, etc. In any such cases, the child is supposed to acquire some of the unpleasant qualities associated with the obnoxious object or act, in a symbolical if not real sense.

In time the child is introduced to the ancestral gods, and a name is given him, which usually has some particular significance, and often relates to some fact in the family history. Daughters are not welcome, and are liable to be given such names as "The no use," or "It doesn't taste well." But many of the unpleasant names that are heard are such as are given as nicknames "for luck"; for, when a child is called by his true name, the evil spirits may learn it and bring harm to him. Circumcision is customary, in connection with which offerings are made for the child's health, and to inform the ancestral gods that the rite has been performed.

The price of brides varies according to their station, and is shared by the girl's relatives, the chief, and the people of the village; but the village people's share gets divided into too small sums to be reckoned in money, and is paid out in little

dried fish, or in salt. Betrothals may take place at a very early age—sometimes before the girl is born, or even when there is no present prospect of a girl.

The bride-seeker, starting on his quest, pays great attention to his dreams. If they are of fire or flood, the matter has a dubious aspect, and he usually gives it up; but to dream of clear water or of receiving money is a good sign. The girl is not consulted, and all is arranged by intermediaries, without the parties seeing one another. A few days previous to the wedding the bride goes round and takes leave of her relatives, with lamentations that she is to be consigned to strangers—for marriages are always between persons of different clans—and receives their wedding-gifts. Then, just in time to be at the wedding, the people of the groom's village march to the bride's village with drum and song, and parade the streets, brandishing their drawn knives and shouting, till a wild dance is started, which passes into a long, serpentine movement with windings and inwindings, and the chanting of a recitative by one of the participants, and the repetition in chorus of the last strophe, or its final sound, which is always a vowel. There is nothing like singing in this, for musical song is not known in Nias. The women dance in pairs, deliberately and gracefully waving the ends of the scarfs which are hung upon their necks. A breakfast follows, and a more elaborate dinner in the evening.

The bride sits through these proceedings with downcast eyes, wearing an air of modest reserve. Previous to her leaving the house, she must be paid for; and then she will not go, and has to be taken out. When she has been successfully brought down the ladder, the groom is called and saunters out from the throng like one of the most indifferent persons in it. Then the heads of the pair are made to touch at the foot of an idol-post which has been planted in front of the house, usually against the resistance of the bride, and they are a married couple. The groom rubs the bride's lips with a certain leaf, telling her she must not be obstinate, and she is led away—for she will not go of herself—between two women.

On arriving at the groom's residence, a kerchief is thrown over the heads of the couple, and the chief gives them his blessing by waving his sword over them. The bride is taken into the house without her taking hold of the ladder—for the rafters are the first thing to be touched by her—and, when she is seated, a boy is placed upon her lap, in token of her becoming a servant, after which she gives betel to her husband.

The groom or his father gives a feast in his turn, at which a consultation of entrails is held after the old Roman fashion, to determine what the character of the bride's life will be. She

is introduced to the ancestral gods, and is expected to take hold of the palm-leaves with which they are decorated.

The first thought when a person becomes critically ill is to prepare his coffin, a hollowed log closed with a plank. The nearest relatives prepare food for him, and receive his farewell. On the approach of the last moment, the dying man's eldest son lays his mouth against the father's, to receive his spirit, which is believed to come from the mouth in the shape of a pebble. If the man has no son, the spirit is received in the money-purse. It is afterward hung upon the ancestral image which is prepared to represent the deceased, and is supposed to enter it. When received by the son, it is thought to help make him a wise and valiant man. After death, mourning is begun with the beating of drums and the firing of guns, if powder can be got. The nose of the deceased is closed, his chin is bound, and his great toes and his forefingers and thumbs are tied together, to facilitate the escape of the immortal part. A dance, not unlike the marriage-dance, is accompanied by chants reciting that the deceased is not really dead, but is only gone away, although he will never return from beyond the seas to the present world. The funeral feast is marked by the number of swine that are slaughtered for it, and this appears to be the question that most occupies the minds of the public when a death is announced. While the coffin is being brought down into the throng of relatives, some may be inquiring whether there are any circumstances to indicate murder; others may be holding before the deceased articles that he highly prized, in order to outbid any persons hostile to the family who might try to entice his spirit away from them.

A pot of chicken and rice is pushed into the coffin for the use of the deceased in the other world. The coffin having been laid in the grave, the stem of a certain plant is inserted so as to stick up through the surface of the ground and form a way of exit for the *mŏkŏmŏkŏ* or relic of the heart, which is expected to rise from the grave in the shape of a little spider—this only in case the deceased has left posterity. While the dead are usually buried as soon after death as possible, if the family have not at hand the swine required for a suitable feast the body may be kept in the house, in a tightly-closed coffin, for a year.

Food is set at the foot of the house-thatch twice a day for a few days after the funeral. The idols which the deceased had had made on the occasion of his sickness, and the articles he had used, are placed by the grave, so that the ghost shall not return to the house for them. A wooden image of the deceased is made, and his immortal part is invited by the priest to take its abode in it.

An amusing ceremony is that of the recovery of the *mŏkŏ-*

mŏkŏ, a little spider which is looked for on the grave, and is regarded as the relic of the heart. Sometimes the ceremony is delayed for several years; and if sickness occurs in the family in the mean time, it is considered an infliction on account of the neglect. The grave having been cleared up, rice is scattered over it, and clothing and jewelry are laid upon it. The family then squat around it, stretch out their hands, and invite the mŏkŏmŏkŏ to come, and delay not; all the relatives are there waiting for it. A piece of clothing is lifted up, and a spider is discovered under it—they are running all around, for that matter, by the dozen. It is not caught at once, but is invited to come upon the outstretched hand. Now it is discovered that it has six legs, and can not be the mŏkŏmŏkŏ spider, for that should have only four legs; no, it is the right one, after all, for two of the supposed legs are only hairs. When the genuine mŏkŏmŏkŏ is found and identified, it is put into a bamboo cane and brought to the *dela* (bridge), a kind of gathering-place of the dead, where a stone is planted for each deceased person, before which potsherds are set to represent a plate and a flask. A kind of festival is held here, after which the mŏkŏmŏkŏ spider is set free close to the ancestral image, which it is supposed to enter. An egg is offered by each person present, and the family are counted over before the image, and prosperity is invoked for each one, as well as for their herds and fields. If a crack appears in the image, which is of wood, they say that the mŏkŏmŏkŏ has escaped from it, and a new image must be made and instituted with a repetition of the ceremonies.

The religion of the Nihas consists really of the worship of demons and of ancestors, while there are two beings who are neither, to one of whom the highest power is ascribed, and whose name is invoked in oaths; but they are worshiped only in an indefinite sort of a way.

Their psychology is very peculiar. Besides the spirit *sheha*, whose transmission to posterity in noble families has been described, they speak of the breath or soul, *noso*, which has a kind of pre-existence—not in a personal form, but as a part of the general soul-stock, from which each person's portion is weighed out or cut off from a line—each one being asked at birth how much of it he will have. Upon his answer, and his consequent allotment, will depend the length of life that he will enjoy. The immortal part, *bechoe zĭmata*—a spirit distinct from the sheha—is regarded as a mere shadow, having a hypothetical continued existence.

A peculiar central position, and a multitude of functions, are ascribed to the heart. It is the seat of thought, understanding, and feeling; and a remnant of it comes out from the grave after

death in the form of a spider, seeking lodgment in the ancestral image, as has been already described.

The Niha conceptions of the condition after death are confused. The *bechoe* go below into the city of the dead, where they have to die nine times, or, according to some, as many times as the man has lived years on the earth, and are supposed to lead lives like the earthly lives. They take with them their earthly utensils and possessions in the form of shadows, and can not expect to attain a higher state of wealth than they did on the earth; therefore living men accumulate as much wealth as possible, in order that they may take the shadow of it with them. The bechoe of wicked men return to the corpse in the grave, and are crushed by the earth. Men who have no male issue are turned after their manifold deaths into night-moths; those who are murdered, into locusts. The bechoe of murdered men and suicides are assigned separate abodes from the other bechoe. At last, it is said, the earth will die, or sink into the sea, and there will be a new earth. Then the bechoe of the cats will let the bechoe of the men go over the gulf into the new earth, the edge of a sword serving as a bridge. Any one who, in life, has causelessly tormented or killed a cat, will be thrown by them into the abyss. Therefore every person is afraid to go near cats to annoy them. Only those also who have had issue can go over, while others become butterflies or something of the kind. The bechoe of children are carried over by their mothers, and go to God.

After Lowalangi, with whom men have little to do except to make an occasional offering, the most important of the divinities is Latoere. He tried to make men from the tora-fruit, and, not succeeding, called upon Lowalangi to help him, and received the creatures as a gift of swine. Hence he is called Latoere of the thousand swine. He occasionally eats a man—that is, his shadow—as one would slaughter and eat a pig, when the fact is manifested by the illness of the victim. In this case an offering is made to induce him to choose another, fatter man, from a different part of the country. If this petition fails, the man will have to die. There are other demons, who feed upon the shadows of men, stalking like hunters through the land, using the rainbow for their net, and assisted by air-dogs, whose heads are turned round so as to look backward, and which are occasionally heard to bark. It is possible, however, by means of special offerings, to make one's self unfailingly sound, unless Lowalangi has decreed that there shall be an end of the person in question. The shadows that fall victims to these divine appetites are special shadows, and not those which are cast in the sun.

The people also imagine underground ghosts, or bechoe, which live in caves or holes, and trouble men or eat their

shadows. The bechoe of women who have died in childbed are supposed to seize men's arms and try to twist them around and set them wrong side foremost. A kind of angelic being is appointed to convey the souls of the dead back to the soul-stock or string from which they were cut off and allotted to their personages at the time of their birth. Next in order are those ancestors who are honored on special occasions, and after them the near ancestors, of whom images are made, which the mŏkŏ-mŏkŏ accepts as its abode. Offerings are made most usually in a propitiatory shape, as when Latoere is asked to choose another man instead of the one he has made ill, or the shadow of a pig or of a hen is offered to the bechoe instead of the shadow of a man.

The priests form a separate class. The sign of the calling to the office is a fit of insanity or some illness. After a spell of wandering, the candidate qualifies himself for his functions by means of a short course of instruction from an active priest.

The minor divinities, or *adoes* (idols), are very numerous; and in order to make sure of accosting the right one for a particular occasion, the priest institutes a kind of ordeal. One of the test-forms is to name the list of the divinities while trying to make an egg rest on a bottle: the one at whose name the egg stands is the right one. A new adoe or idol has to be carved for every case of illness; and the offering is made while the patient is holding the image in his hand, with drumming and prayers. In invocations of Latoere, three mediators are employed between the priest and the god; the adoe, which is asked to transmit the matter; Saho, who was formerly a man on the earth, but has been translated to the sky, who intercedes with the third mediator, a being whose part in the affair is not very clear.

If the prayers find a hearing, Saho reveals the sign, which is manifested in a great wave or cloud floating above, but can be received only by sunlight. The priest intercepts it with a cloth, upon which it is reflected, in a shape like that of a glow-worm, and puts it upon the patient's brow, whereupon he is made well. This sign, called *soemange*, is also received in answer to many other offerings which are not made to Latoere, but it always comes from him, upon whom life or death ultimately depends. Offerings to the ancestral gods are seldom made in cases of illness, but usually to ask a blessing or avert misfortunes, or on special occasions, as the birth of a child or a marriage, in the way of announcement. These divinities are held in very high honor, and all manner of evil is predicted against any one who renounces them and goes over to Christianity.

A sin-offering is made for a chief who in any affair or case of offense has not done right, and is afraid that he will be made

ill on account of it. The adoe of some former (deceased) magistrate is then called upon to turn away the evil; and when any one is cursed, he endeavors to ward off the effect of the imprecation by an offering. Adoes are also made and offered to drive off evil spirits or to warn off the spirits of pestilence that may be approaching the village. The occasions for offering are, in fact, innumerable, and persons who suffer much from illness are made poor on account of them.

The adoes are supposed to have originated from above; and the kinds of wood out of which the idols are made are the children, turned into wood, of the divinities which, according to one version of the legends, sprang from chips of wood, and were sent down to heal the diseases of the earth.

Diseases which are supposed to have been produced by curses and enchantments are also met by offerings; but a certain list of disorders, which are caused by a tree that is supposed to have arisen from the spirit of a curse which was uttered by a certain chief against his townsmen—including fevers, disorders of the stomach, and contagious skin-diseases—have to be treated with medicine. The field of superstition is much better tilled by the Niha people than are their rice-fields.—*Translated for the Popular Science Monthly from the Allgemeine Missions-Zeitschrift.*

ANIMALS AS MODIFIED BY ENVIRONMENT.*

By J. B. STEERE,

PROFESSOR OF ZOÖLOGY IN MICHIGAN UNIVERSITY.

THE close connection between animals and their surroundings is generally recognized both by those believing in creation by design and by those holding to evolution. This connection is usually supposed to be restricted to the adaptation of certain organs to specific facts of surrounding environment. Often-quoted examples of such related organs and conditions are the eye and light, and the ear and sound.

In addition to this undoubted adjustment of single organs to individual conditions of environment, there is reason for believing that each natural division of the great animal types, the most fundamental as well as the most trivial, is adapted in the same sense to its own special fact of environment. In other words, all modifications of type have been in the line of adaptation to special conditions; and, where such modifications are

* Abstract of a paper on "The Importance of Individual Facts of Environment in the Formation of Natural Groups of Animals," read before the American Association for the Advancement of Science, Ann Arbor meeting, 1885.

distinct enough to be recognized by the classifier, the facts of environment on which they depend should be distinct enough to be discovered by the observer of animal habits.

This proposition can be established only by the connection of structure with habits and with conditions of environment in a large number of groups of different values in each of the types. Its reasonableness is best shown by the fact that it is recognized as true in those groups whose habits and structure are best known. The difficulty of establishing it as a general truth lies rather in the lack of knowledge of animal habits and surroundings than in a lack of knowledge of structure.

A few undoubted examples of adaptation of groups to special environment are of birds to aërial habitat, of fishes to water, of rodents to hard foods, and of squirrels to arboreal seeds with hard coverings.

One of the difficulties in tracing this connection between existing groups and the environment to which they are adapted is in this, that the more fundamental structural characteristics may remain after the animal possessing them has, by later superficial modifications, become adapted to other and perhaps antagonistic conditions, and even after the conditions leading to such structures have disappeared. Of the first case we have such examples as the ostrich and penguin, which, while retaining their bird characters, have lost flight, and have become, one of them terrestrial and the other aquatic; and the bats and whales, mammals which are no longer capable of existing in the normal mammalian habitat.

Of examples of the last case, animals existing after the conditions leading to their existence have disappeared, we can not be so sure; but the marsupials and the proboscidians among mammals, and the turtles among reptiles, may be examples in point. If animals may become superficially modified so that they may exist under conditions different from those for which they were primarily fitted, they might still exist after such primary conditions had ceased to exist. Whales might exist if all land were destroyed.

Another difficulty in connecting animal forms with special conditions of environment is in the multitude and variety of modifications that have taken place. No type of animal life has stopped at one set of changes. If there was one species of bird, and that fitted in a general way for all bird-life, one of mammals, one of fishes, etc., the problem would be simple; but as soon as a group of animals has become adapted to a new fact of environment it falls under the influence of a new set of surroundings, more or less numerous, from the very fact of such change, and again becomes broken up into subdivisions adapted to each of

these. This process is repeated again and again until groups of animals are reached in which the differences of structures separating them from others become so minute that they are called varietal or specific, while the differences of environment to which these subdivisions are adapted grow fainter and fainter, until, when the point is reached where the classifier is compelled to throw together a number of animals and call them a species, because he can no longer find structural differences to form divisions upon, there the student of animal habits will find the same animals related to practically identical facts of environment.

An example of such changes in environment and of such following modifications of structures may be taken from the mammals. Primarily arboreal in habits, and climbing, with hands developed on one or both pairs of limbs, their skulls and jaws and teeth were fitted for masticating their food. All of their supposed ancestry had simply swallowed their food whole.

This mammalian character of the teeth, when attained to, made of importance, for the first time, such differences of foods as necessitated different kinds of teeth for masticating them. Examined in this respect, the food ordinarily made use of by mammals may be roughly divided into five classes—fruits, insects, flesh, grass, and hard foods—and these have led to the formation of the five great orders: primates, insectivores, carnivores, ungulates, and rodents. The importance of these food characteristics in modifying mammals may be seen when it is stated that these five orders, with the bats, which are flying insectivores, contain five sixths of the mammalian species and probably more than nineteen twentieths of all the individuals of the class. Again, the becoming fitted for hard foods, by the rodents, brought them under the influence of a new set of surroundings, namely, the various locations in which such foods existed, and the families of squirrels, mice, hares, beavers, etc., are the result. The same process again took place in the formation of the genera and species of these families.

We must look upon the class, order, family, genus, and species characters of each individual animal as structures which fit it or have fitted its ancestors for as many distinct facts of environment. The later gained and more trivial structures may overlie and obscure the more ancient and fundamental ones, like the later writings on an old palimpsest, but all are to be made out by the skillful anatomist. As has been said, the line of modification is not always a direct one, but it is often so deflected that structures which were primarily adapted to one fact of environment may be modified secondarily to fit them for others which are opposed and antagonistic to the first. The

examples of swimming and running birds without flight, and of marine and aërial mammals, have already been given. In these cases, the fundamental structures become in part worn and mutilated, and some of them entirely lost. Some of the running birds have lost a large part of the bones of the wing, and the whales have lost the hinder limbs. Such mutilation and loss of parts is proof that the animal which has suffered them has departed from the environment of its ancestors.

But though deflection and antagonism of structures is possible and frequent, it is necessarily not usual; later modifications of structures are ordinarily in harmony with more fundamental ones, and later conditions of environment with primary ones. Progress is ordinarily easiest in a straight line. Most fishes live in the water and swim, though they become variously modified for the various secondary conditions found in this medium. Most birds fly, though they are subjected to endless modifications which are in harmony with flight. The mass of shot show the spot aimed at, and not the scattering pellets. When later modifications are in agreement with primary ones, the primary structures remain in full perfection and use.

The facts of environment bearing upon life are so various and so heterogeneous that they allow of but little classification. Those conditions which have existed pretty generally over the earth, and with little or no change since the creation of life, have had the most profound modifying influence. Among these are the different mediums respired, air and water, and the different horizons or locations requiring peculiar organs of locomotion, deep and shallow water, earth, rocks, and trees, and air. The divisions of types which are usually dignified by systematists with the title of classes have their reason for existence in conditions of this kind. The five recognized classes of vertebrates—fishes, amphibians, reptiles, birds, and mammals—are simply modifications of type for life in water, in shallows, on land, on trees and rocks, and in the air.

But these conditions are not confined to this first influence upon the types. Being in continual and unchanged existence, they again had their influence, among other conditions, in forming the secondary divisions of the type, that is, the groups called orders, and have caused many or all of the deflections of these from the class-lines of structure. In the mammals the order of whales and bats, and in a less degree the ungulates, are cases in point. Among the birds, the ostriches, with the ordinary wading, running, and swimming birds, are examples. Even in the orders the influence of these great primary conditions is not lost, but with less and less power, as the specializations of family, genus, and species are reached, they still show their force in

such families as the beaver, in such genera as the otter and muskrat and flying-squirrel, and in such species as the water-hare of the Southern States.

In addition to the class of conditions above mentioned which have led to fundamental differences of breathing organs and of organs of locomotion especially, there are others which have had a much more superficial effect in modifying life. These are such as foods, enemies, climate, and perhaps others too subtile to be known at present. These differ from the first in having come into existence, many of them, since the creation of life, and in having been in a continual state of change. The groups called orders, families, genera, and species, depend on these in most cases for their reason for existence. The structures modified lead to differences of size, color, shape, teeth, or other organs of food-taking, and secondary modifications of the organs of locomotion. Like the first class of conditions mentioned, these may also by their continual existence cause modifications in other groups than those especially and primarily fitted to them. The primates are fruit-eaters and the bats are normally insect-eaters; but the fruit-bats are secondarily modified in teeth, size, stomach, etc., for fruit-eating.

The groups founded on these secondary and changing conditions have also been in a corresponding state of change, old forms disappearing and new ones taking their place. Where facts of this second class have approached stability, the groups corresponding have partaken of this character in the same degree. The foods which became such important factors in the modification of mammals must have at a very early period taken on the general characters of fruits, flesh, insects, grass, and hard substances, and the great orders were at an early period formed and have remained, and must do so while the earth exists in anything like its present state.

Many of the so-called families are also based upon conditions which have a good degree of permanence; but as the lesser groups are approached the facts of environment upon which they are established become more and more narrow and more capable of either destruction or change. While the general class of hard foods may remain as long as terrestrial life exists, particular kinds of nut-trees or of grains may disappear, and with them species and even genera depending upon them for existence. As the conditions leading to the formation of the lesser groups grow more narrow in their character, being limited perhaps by a single species of food, the location in which this condition exists becomes restricted also, and so the chances for its destruction are increased. But very many of the changes among the ultimate groups are not by destruction, but by change of the conditioning

environment slow enough to be accompanied by change of the species depending upon it. There can be but little doubt that many if not most or all of existing species are slowly changing in mass and in place into something else than what they are now. This process may be so slow that it will require some such careful study and delicate calculation as has been used by astronomers to prove that the so-called fixed stars are in motion; but the well-founded belief that geological changes are still going on upon the earth is enough to make us certain that changes in living things must accompany these or follow close after.

In addition to such slow changes of the mass of individuals of a species as must finally produce a form specifically different from it, there is another method of formation of species which would seem to be much more prolific in its results, and which alone can keep the earth populated during ages of changes of environment, some of them so rapid and violent that they destroy great numbers of species. This is by the migration of individuals into surrounding areas where the conditions are so near like those to which they are accustomed that they can exist, and still different enough to set up rapid changes of structure. The offshoots of the parent species might thus become numerous, and still retain likeness enough to each other so that they would be thrown by the systematist into a common genus; or, if the changes of environment were less, we should have a set of subspecies or varieties. There is no line or rule fixed in nature by which we can say that this is a genus with several species, and this is a species with several varieties. If this is a true theory for the creation of species, there should exist certain species settled and fixed in character, which have existed with but the slow modifications of structures caused by geological changes, while other species would be ready to change in any direction, or to revert rapidly to the characters of its parent species. The varieties and species of man's make are exaggerated examples of the latter class, and man himself would furnish illustrations of the same thing in such ancient and well-established species as the Chinese, and such a recently-formed variety as the Anglo-American. The heterogeneous character of the conditions of environment bearing upon life, and their utter lack of equality or equivalence of modifying power, give good and sufficient reason for that lack of equality of structural values among groups, which is best shown by the inability of the best systematists to agree upon their value. The fate of the group called species is a case in point. As long as the animals of a single well-defined area were studied, there was no difficulty, for closely-allied species necessarily rarely or never inhabit the same area; but as soon as the study became comparative, by bringing in forms from neigh-

boring areas, species lost its significance as a term of fixed meaning, and can not be separated from genus on one side and subspecies or variety on the other.

Though the examples made use of in this discussion are taken from the vertebrate type of animals, the other great divisions fall under the same law, each in its own way, and under limitations set by the characters of the types themselves.

THE IMITATIVE FACULTY OF INFANTS.*

By Prof. W. PREYER.

TO determine as exactly as possible the date of the first imitative acts is of especial interest in regard to the genesis of mind, because even the most insignificant imitative movement furnishes a sure proof of activity of the cerebrum. For, in order to imitate, one must first perceive through the senses; secondly, have an idea of what has been perceived; thirdly, execute a movement corresponding to this idea. Now, this threefold central process can not exist without a cerebrum, or without certain parts of the cerebrum, probably the cortical substance. Without the cerebral cortex, certain perceptions are possible, to be sure; many movements are possible, but not the generation of the latter out of the former. However often imitation has the appearance of an involuntary movement, yet when it was executed the first time, it must have been executed with intention—i. e., voluntarily. When a child imitates, it has already a will. But the oftener a voluntary movement is repeated, always in the same way, so much more it approximates reflex movement. Hence many imitative acts, even in the child, occur involuntarily quite early. But the first ones are willed. When do they make their appearance?

If we make, for the infant to see, a movement that he has often practiced of his own accord, he can make a successful imitation much earlier than is commonly supposed. Such a movement, which I employed as suitable for early imitation, is the *pursing of the mouth*, the protruding of the closed lips, which often occurs (even in adults), along with a great strain of the attention.

This protruding of the lips occurred with my child on the

* From "The Mind of the Child: Part I. The Senses and the Will." Being observations concerning the mental development of the human being in the first year of life. By W. Preyer, Professor of Physiology in the University of Jena. Translated from the German by H. W. Brown, with an Introduction by G. Stanley Hall. New York: D. Appleton & Co., 1888.

tenth day of life (in the bath, when a burning candle was held before him at the distance of a metre); in the seventh week it was decidedly marked at sight of a new face quite near him; in the tenth week, at the bending and stretching of his legs in the bath. It was as if the letter *u* were to be pronounced—and yet the child was wholly unable to imitate this movement so easily made by him (as late as the fourteenth week) when I made it for him under the most favorable circumstances. At the end of the fifteenth week appeared for the first time the beginnings of an imitation, the infant making attempts to purse the lips when I did it close in front of him. That this was a case of imitative movement is shown by the imperfect character of it in comparison with the perfect pursing of the lips when he makes the movement of his own accord in some other strain of the attention. Strangely enough, the imitation was attempted on the one hundred and fifth day, but not in the following days.

Further attempts at imitation occurred so seldom and were so imperfect, notwithstanding much pains on my part to induce them, in the following weeks, that I was in doubt whether they might not be the result of accidental coincidences. Not till the seventh month were the attempts to imitate movements of the head, and the pursing of the lips already spoken of, so striking that I could no longer refer them to accidental coincidence. In particular the child often laughed when one laughed to him (p. 145). The attention is now more and more plainly strained when new movements are made for the infant to see—he follows these with evident interest, but without coming to the point of an attempt at imitation in a single instance. This indolence was the more surprising, as even in the seventeenth week the protruding of the tip of the tongue between the lips (customary with many adults at their work) was perfectly imitated once, when done by me before the child's face, and the child in fact smiled directly at this strange movement which seemed to please him. Imitative movements thus appear in the fourth month, which in the seventh, and even the ninth, do not succeed or are quite imperfectly achieved. Yet in the tenth month correct imitations of all sorts of movements were frequent, and it is certain that these were executed with distinct consciousness; for, when he is imitating movements of hand and arm frequently repeated before him—e. g., *beckoning* [in the general sense of making a sign] and saying—"Tatta"—the child looks fixedly at the person concerned, and then often suddenly makes the movement quite correctly.

Beckoning (*Winken*) is in general one of the movements of the infant acquired early by imitation. In my child it appeared for the first time at the beginning of the tenth month. When

he was going to be taken out, his mother used to make a sign to him, and now he likewise made a sign, almost invariably, in the doorway, with one arm, frequently with both arms, yet with an expression of face that indicated that he moved the arms or arm without understanding, upon the opening of the door. The proof of this lies in the fact that, when I enter the room, the child, so long as the door is in motion, makes that movement which he at first only imitated, and does it regularly—no hint of leave-taking in it, therefore. The beckoning movement is made also at other times—e. g., on the opening and shutting of a large cupboard; it has, therefore, completely lost its purely imitative character. The movement consists essentially of a rapid raising and dropping of the extended arm; it is not, therefore, genuine beckoning. Not till after some weeks were motions of the hand added, and this more skillful imitation made it seem as if the machine-like movements that were made at the opening of the door were less and less involuntary, were more and more intentionally performed as genuine signs of leave-taking. But at this period (tenth month) such an action is not yet admissible; for when I make the same beckoning movement for the child without opening the door, he repeats it often in a purely imitative fashion without deliberation, though, to be sure, the eye has an expression of great strain of attention, on account of the difficulty of comprehending so quick a movement.

Not every imitative movement can be so clearly perceived to be willed as can this one. When one enters a room in which there are a good many infants, all quiet, one can easily observe the contagious influence of crying. For, if only one child begins to cry, then very soon several are crying, then many, often all of them. So, too, when one single infant (in the ninth month) hears other children cry, he likewise, in very many cases, begins to cry. The older the child becomes, the more seldom appears this kind of undesirable imitation; but even in children four years old, quite aimless imitative movements may often be perceived (as in mesmeric patients) if the children are observed without their knowledge. For example, they suddenly hold the arms crossed, as a stranger present is doing, and bow as he does at leaving.

A little girl in the last quarter of her first year imitated, in the drollest fashion, what she herself experienced in her treatment by the nurse, giving her doll a bath, punishing it, kissing it, singing it to sleep; and before the end of the first year she imitated the barking of the dog and the bleating of the sheep (Frau Dr. Friedemann).

Another female child imitated the following movements in a recognizable manner: in the eleventh month she threatened with

the forefinger if any one did so to her, used a brush after she had seen brushes and combs, used a spoon properly, and drank from a cup, and made a kind of cradling movement with her doll, singing, "Eia—eia." In the thirteenth month the child made the motion of sewing, of writing (moistening the point of the pencil in her mouth), and of folding the arms. In the fifteenth month she fed the doll as she was fed herself, imitated shaving, on her own chin, and reading aloud, moving her finger along the lines and modulating her voice. In the eighteenth month she imitated singing, and made the motion of turning a crank like a hurdy-gurdy player when she heard music; in the nineteenth she went on hands and feet, crying "Au, au!" (ow, ow), in imitation of a dog; in the twentieth she imitated smoking, holding a cane firmly with her fingers exactly as is done in smoking a pipe. Her younger sister, in her fifteenth month, first imitated the movement of sewing and of writing; while the elder, in the nineteenth month, after repeated attempts at imitation, sewed together two pieces of cloth, without instruction, drawing the needle through correctly (Frau von Strümpell).

Toward the end of the first year of life the voluntary imitative movements, more numerous than before, are executed much more skillfully and more quickly. But when they require complex co-ordination they easily fail. When (at the beginning of the twelfth month) any one struck several times with a salt-spoon on a tumbler so that it resounded, my child took the spoon, looked at it steadily, and then likewise tried to strike on the glass with it, but he could not make it ring. In such imitations, which are entirely new, and on that account make a deeper impression, as in the case of puffing (*Pusten*), it would happen that they were repeated by the child in his dreams, without interruption of his sleep (twelfth month), a proof that the experiences of the day, however unimportant they appear to the adult, have stamped themselves firmly upon the impressionable brain of the child. But it takes always some seconds before a new or partly new movement, however simple, is imitated, when it is made for the child to imitate—e. g., it was a habit of my child (in the fourteenth month) to move both arms symmetrically hither and thither, saying, "ay—ĕ, ay—ĕ" (altogether differently, much more persistently and rapidly, than when beckoning). If some one made this very swinging of the arms for the child to observe, with the same sound, there was always an interval of several seconds before the child could execute the movement in like fashion. The simplest mental processes of all, therefore, need much more time than they do later. But imitations of this kind are almost always performed more quickly when they are not sought, when the child-brain is not obliged first to get its bear-

ings, but acts spontaneously. If I clear my throat, or cough purposely, without looking at the child, he often gives a little cough likewise in a comical manner. If I ask, "Did the child cough?" or if I ask him, "Can you cough?" he coughs, but generally copying less accurately (in the fourteenth and fifteenth months). The bow too tightly strained shoots beyond the mark.

Here, besides pure imitation, there is already understanding of the name of the imitated movement with the peculiar noise.

This important step in knowledge once taken, the movements imitated become more and more complicated, and are more and more connected with objects of daily experience. In the fifteenth month the child learns to blow out a candle. He puffs from six to ten times in vain, and grasps at the flame meantime, laughs when it is extinguished, and exerts himself, after it has been lighted, in blowing or breathing, with cheeks puffed out and lips protruded to an unnecessary degree, because he does not imitate *accurately*. For it can hardly be that a child that has never seen how a candle can be blown out would hit upon the notion of blowing it out. Understanding and experience are not yet sufficient to make this discovery.

I find, in general, that the movements made for imitation are the more easily imitated correctly the less complicated they are. When I opened and shut my hand alternately, merely for the purpose of amusing the child, he suddenly began to open and shut his right hand likewise in quite similar fashion. The resemblance of his movement to mine was extremely surprising in comparison with the awkward blowing out of the candle in the previous instance. It is occasioned by the greater simplicity. Yet, simple as the bending of the finger seems, it requires, nevertheless, so many harmonious impulses, nerve-excitements, and contractions of muscular fibers, that the imitation of simple movements even can hardly be understood without taking into account the element of heredity, since unusual movements, never performed, it may be, by ancestors—say, standing on the head—are never, under any circumstances, imitated correctly at the first attempt. The opening and shutting of the hand is just one of the movements by no means unusual, but often performed by ancestors. Still, it is to be noticed that at the beginning the imitation proceeded very slowly, although correctly. On the very next day it was much more rapid on the repetition of the attempt, and the child, surprised by the novelty of the experience, now observed attentively first my hand and then his own (fifteenth month).

Of the numerous more complicated movements of the succeeding period, the following, also, may be mentioned, in order to show the rapid progress in utilizing a new retinal image for

the execution of an act corresponding to it: A large ring, which I slowly put on my head and took away again, was seized by the child, and put by him in the same way on his own head without fumbling (sixteenth month). But, when it is a case of combination of a definite action of the muscles of the mouth with expiration of the breath, innumerable fruitless efforts at imitation are made before one of them succeeds, because, in this case, a part only of the working of the complicated muscular action can be perceived, while the rest must be found out by trial. Thus, the child could not, in spite of many attempts, get any tone out of a small hunting-horn. He put it to his mouth, and tried to imitate the tone with his own voice. Suddenly the right manner of blowing was hit upon accidentally, and from that time was never forgotten (eighteenth month).

After the child had seen how his mother combed her long dark hair before a glass, he took a hand-mirror and a comb and moved the comb around on his head, combing where there was no hair. So, too, he would now and then seize a brush and try to brush his head and his dress, but took special pleasure in brushing also all kinds of furniture. More than once he actually took a shawl, held it by a corner to his shoulder, and drew it behind him like a train, frequently turning around while doing this. He also put a collar round his neck; he tried to dry himself with a towel, but without success; whereas the washing of the hands with soap, without direction, was imitated, though not with much skill, yet tolerably well; none but very complicated imitative actions these, and all of them, in the case of my boy, belong to the third quarter of the second year—an exceptionally important period in mental genesis—the same is true of seizing, holding things before him, and (what was observed by Lindner in the sixth month) the imitation of reading aloud from a newspaper or pamphlet, the feeding of deer—holding out a single spear of grass to them—scraping the feet upon entering the house (as if the shoes were to be cleaned).

But how little real imitation and understanding of the act itself there was, even in this period of perfect external imitations, appears from the circumstance that a map is held, as a newspaper, "to be read aloud," before the face, and upside down. Now, too, the child likes to take a pencil, puts the point in his mouth, and then makes all sorts of marks on a sheet of paper, as if he could draw.

Just as remarkable is the lively interest in everything that goes on in the neighborhood of the child. In packing and unpacking, setting the table, lighting the fire, lifting and moving furniture, he tries to help. His imitative impulse seems here almost like ambition (twenty-third month).

Toward the end of the second year various ceremonious movements, especially those of salutation, are also imitated. The child sees how an older boy takes off his hat in salutation; immediately he takes off his own head-covering and puts it on again, like the other boy.

All these movements last enumerated are distinguished from the earlier ones by this, that they were executed or attempted by the boy unsolicited, without the least inducement or urging, entirely of his own motion.

They show, on the one hand, how powerful the imitative impulse has become (in the second year); on the other hand, how important this impulse must be for the further mental development. For, if the child at this age passes the greater part of his time in company inattentive to manners, or unrefined, then he will imitate all sorts of things injurious to him, and will easily acquire habits that hinder his further development. It is, therefore, of the greatest importance, even at this early period, to prevent the intercourse of children with strangers, and to avoid everything that might open wrong paths to the imitative impulse.

The imitative movements of the muscles of speech, the child's imitations of sounds, syllables, and words are treated of in detail in the third part of this work. The first answer of the infant to the language addressed to him by his relatives, which is said to be made, in individual cases, as early as the eighth and ninth weeks (according to Sully, 1882), is no attempt at imitation, but a directly reflexive movement, like screaming after a blow, etc. Singing has already been mentioned as one of the earliest imitated performances. It is true of these, as of all later imitations, that the first imitation of every new movement is voluntary on the part of the child, and, in case an involuntary imitation seems to occur, then either this has already been often repeated as such, or it is a movement often practiced without imitation. The accuracy of the imitation depends little, however, upon the co-operation of a deliberative cerebral activity. On the contrary, children of inferior mental endowment among those born deaf sometimes possess (according to Gude) a purer and more distinct enunciation than those more gifted.

A REVISION of the calendar has been proposed by M. Gaston Armelin to the Astronomical Society of France, the object of which is to have the same day of the month always come on the same day of the week. He would divide the year into four quarters of ninety-one days or thirteen weeks each—making three hundred and sixty-four days—and would leave the three hundred and sixty-fifth day as a supplementary day, outside of and additional to the weekly and monthly reckoning. All the months should be uniformly thirty and thirty-one days each, their length being fixed so as to fit exactly into the three-monthly reckoning.

THE FLAME OF A CANDLE.

By C. FIEVEZ,

ASTRONOMER AT THE ROYAL OBSERVATORY AT BRUSSELS.

THE little yellow candle-flame, which is gradually disappearing from our households to give place to brilliant gas and electric lights, still plays a considerable part in the labors and researches of physicists, chemists, and astronomers. The former find in it a source of heat capable of melting and oxidizing or reducing the most refractory metals. The last employ it as a photometric unit, both to measure the most considerable lights and to determine the luminosity of stars so faint that they can hardly be seen in the great telescopes. But the most curious and interesting thing about this little flame is the fact that the optical study of it has contributed very largely to our knowledge of the elementary composition of the celestial bodies.

Carefully examined with the naked eye, the flame of a candle is composed of three distinct layers or envelopes, viz., a dark central part, the dark cone around the wick, formed of gaseous products of low temperature, and holding in suspension carbon in a state of fine division, but not yet incandescent; a luminous part, surrounding the dark part, and composed of carbon raised to a bright incandescence; and a thin external envelope, only faintly luminous and faintly colored, yellow toward the top, where the carbon is completely burned, and bluish toward the base, where the primary products of the decomposition of the matter of the candle are burning in contact with the air.

Analyzed by the aid of the spectroscope, the luminous cone gives a brilliant and continuous spectrum—that is, one having the appearance of a ribbon exhibiting all the colors of the rainbow, while the exterior, faintly luminous envelope gives a discontinuous spectrum formed of three bright bands—one yellow, one green, and one blue.

As only solid incandescent bodies are capable of giving a continuous spectrum, we conclude that carbon in the solid state is incandescent in the luminous envelope of the flame. But, the spectrum of the exterior envelope being discontinuous, we conclude that it is composed entirely of gaseous products.

The flame of illuminating gas presents, both to the naked eye and in the spectroscope, the same aspect as the flame of the candle, whence it is concluded that its lighting and heating powers are derived from the same cause—the more or less complete combustion of carbon.

By blowing air or injecting oxygen through the blow-pipe into a candle-flame or a gas-light, its aspect is greatly changed.

The bright envelope nearly all disappears, while the inner dark cone is considerably developed, reaches a very high temperature, and exhibits a spectrum identical with that of the outer cone of the original flame. The brightness of the spectral bands is augmented by the rising of the temperature, and two new luminous bands, a red and a violet one, become visible in the spectroscope. At this moment we recognize that these bands are composed of a series of rays or bright lines, separated from one another by dark spaces.

While performing the prismatic analysis of the inner cone of a gas-light flame fed with pure oxygen, M. Stas observed, with the same spectroscope, a spectrum sensibly different as to the number of rays constituting the bands, according as the observation was made upon the top of the inner cone, where the temperature is highest and sufficient to keep iridium in fusion, or on the front or the side of this inner cone. The physiognomies of these three spectra vary according to the spectroscope employed. If we use a spectroscope with direct vision and weak dispersion, we observe a spectrum resembling that of the candle-flame; but, with an instrument of more considerable dispersive power, the bands define themselves into brilliant rays, some fine, and others broad, having extremely clear edges. These facts, M. Stas remarks, inseparably connect the *facies* of the spectrum of the flame with its greater or less elevation of temperature, and with the analyzing instruments employed.

Although the luminous intensity of the inner cone of the oxyhydrogen-flame is quite weak, Mr. Piazzi Smyth has discovered more than 400 bright rays in the spectral bands of this cone; viz., 97 rays in the red, 94 in the yellow, 97 in the green, 107 in the blue, and 71 in the violet bands.

But it is the analysis of the electric arc, the light of which does not differ essentially from that of the candle—for it is also the result of the ignition of carbon—that shows us these spectral bands in all their splendor, and initiates us into the grand complexity of their constitution. Like a luminous ribbon passing insensibly from one shade to another with diminishing brilliancy, each band is composed of a considerable number of bright rays of different breadths, disposed with a wonderful symmetry, increasing with the power of the analyzing instrument and the luminous intensity of the electric arc; the broader bright rays doubling into finer rays, and new luminous rays appearing in the dark spaces that separate the bright rays. While these bright lines are not arranged rigorously in the same manner in each band, they nevertheless show a great resemblance in their grouping and spacing.

In order to show how far the resolution into bright lines of

the spectral bands of the electric arc (which are identical with those of the candle and the oxyhydrogen blow-pipe) may be carried, I have published a specimen of the *facies* of the yellow, green, and blue bands, indicating the intensity and normal distance of the rays composing them. It appears, from this work, that, for a fifth part alone of their total length, these bands show, respectively, 163, 160, and 120 lines; this would bring to about 800 the number of lines constituting each band, and to at least 4,000 the number of the lines forming the five bands of the spectrum of the electric arc; for the more intense bright lines are doubled again when they are observed under conditions favorable to their brilliancy and dispersion. In comparing, with the same spectroscope, the spectrum of the electric arc and the solar spectrum, we observe that the former spectrum displays a more considerable number of bright rays than the solar spectrum of dark rays. Since it is nearly certain that the spectral bands belong to the spectrum of carbon—for they are observed when the electric arc shines in a vacuum, that is, when carbon alone is in ignition—it follows that the spectrum of this element contains more rays than the entire solar spectrum.

Some physicists doubted for a long time the identity of the spectra of carbon and the candle-flame, because there existed a spectrum of carbon entirely different from the banded spectrum. But as I have succeeded in demonstrating, on the one hand, that this spectrum does not belong to carbon, and on the other hand that the spectrum of the candle-flame was brightly visible in the ignited filament of the incandescent lamp when the vacuum is as perfect as it is possible to make it, I think there should now be little doubt respecting the identity of the two spectra. Carbon, being found in various combinations everywhere on the surface of the globe, should of necessity reveal its presence in most of the bodies subjected to spectrum analysis. Eminent chemists have even found traces of it in the nearly perfect vacuum of our pneumatic machines.

The absorption spectrum of carbon, or that which should be composed of the dark lines detaching themselves upon a continuously bright spectrum, has not yet been obtained. In the comparative study that I have made of the solar spectrum and the spectrum of carbon, I have shown that most of the bright rays forming the carbon bands do not coincide with the dark rays of the solar spectrum. I have been inclined to believe from this that the absorption spectrum of carbon does not exist in the solar spectrum, but I have not been able to declare the same conclusion respecting the emission spectrum—that is, the spectrum with bright bands—because the discovery of the bright bands in the solar spectrum offers a real difficulty, resulting from the fact

that the bright rays can be recognized on the bright part of the solar spectrum only by the difference of their brilliancy. On the other hand, we have not recognized the presence of the emission spectrum of carbon among the numerous bright rays observed in the spectrum of the solar atmosphere; and this fact goes to indicate the absence of carbon among the constituent elements of the sun. But such an assertion can not be made until our acquaintance with the subject becomes more complete and clear.

Although it is hardly possible, in the actual state of our knowledge, to establish the presence of carbon in the sun, it is extremely easy to recognize it in the spectra of comets. In 1868, when the comets of Winnecke and Brorsen appeared, Secchi in Italy, Huggins in England, and Wolf in France, studying the spectra of those stars in respect to their composition, discerned that the three bright bands, yellow, green, and blue, of which they were formed, could be regarded as analogous with the spectrum of carbon. It is possible, in fact, in a gas-light re-enforced by oxygen, if the brightness of the flame is reduced and a spectroscope of feeble dispersion is used, to obtain a spectrum exactly like that of a comet. After these observations, Mr. Christie and myself recognized the violet band in the spectrum of the comet *b* of 1881, and Dr. Young has found that the green band, or the most brilliant one in the spectrum of this comet, is formed of rays like the corresponding green band of the spectrum of flame. The identity of the two spectra is therefore demonstrated.

The presence of carbon is also suspected, if not definitely recognized, in the spectra of certain stars, the orange or red color of which indicates a temperature of relatively inferior elevation. The spectra of these stars consist of several dark bands, superposed upon a continuous bright spectrum, which present a great similarity of aspect and position with the luminous bands of the spectrum of carbon in comets, illuminating gas, and the candle-flame. We have then, here, the absorption spectrum of carbon. The spectral analysis of the candle-flame thus permits us to discover by optical methods the presence of one of the most important elements of our globe in luminous bodies, whether celestial or terrestrial, whatever their distance, even though it be so great that light occupies thousands of years in coming to us.—*Translated for the Popular Science Monthly from Ciel et Terre.*

WHILE generally accepting Mr. James Murray's views regarding the formation of barrier reefs and atolls, Mr. J. L. Wheaton would regard as the principal agent in forming the interior lagoons, not the solution and washing out of dead coral by sea-water, but privation of the inner part of the reef of food, all nourishment having been absorbed by the corals of the outer reef from the water before it reaches the interior.

SKETCH OF ALPHEUS SPRING PACKARD.

By Professor J. S. KINGSLEY.

THE influence which Louis Agassiz had in the development of American science is to be estimated not by his published works, but by the enthusiasm he instilled into all who came under his instruction. In the years from 1861 to 1864 there were gathered at Cambridge as his pupils eight men, each of whom has made a name for himself in science. These eight were Alexander Agassiz, Alpheus Hyatt, Edward Sylvester Morse, Alpheus Spring Packard, Frederick Ward Putnam, Samuel Hubbard Scudder, Nathaniel Southgate Shaler, and Addison Emory Verrill.

Alpheus Spring Packard, the subject of the present sketch, is one of the four sons of the venerated Prof. Packard who for over sixty years was connected with the faculty of Bowdoin College. He was born at Brunswick, Me., February 19, 1839, and at the age of eighteen entered the college where his father was a professor. While a student he evinced a marked predilection for natural history, a tendency which was fostered and encouraged by the late Dr. Paul A. Chadbourne, who at that time was a professor in both Williams and Bowdoin Colleges. At Williams there was a flourishing students' society, the Lyceum of Natural History, which at this time had sent out several scientific expeditions, and in the summer of 1860 they laid their plans for another, the objective points of which were Labrador and Greenland. When the expedition set sail from Thomaston, Me., young Packard joined it and went as far as Labrador, where he spent fifty days collecting near Caribou Island. The others went to Greenland, and on their return took him and his collections back to the States in time for him to begin the studies of his senior year. These, however, were not without interruption, for before graduation he led a party of classmates on a dredging and collecting expedition to the Bay of Fundy.

At commencement in 1861 Bowdoin gave him his bachelor's degree, and then the field was opened to him to follow his scientific bent. In the spring of that year the Legislature of Maine had authorized a scientific survey of the State, and Mr. Packard received the appointment of entomologist on the corps. In this capacity he accompanied a party who went up the east branch of the Penobscot and then down the Alleguash and St. John's Rivers as far as Woodstock. With the materials gathered on this expedition Mr. Packard wrote the first of that long series of scientific articles which have emanated from his pen. It was an essay on the army-worm, which at that time was doing considerable damage to agricultural interests in Maine. This paper,

with others by the same author, was published in the first report of the survey.

Mr. Packard had now fully decided to devote himself to zoology, and, in order to widen his views and increase his knowledge, he went to Cambridge to study with Agassiz. Here for three years he devoted himself to entomology and made such progress that during the latter part of the time he held the position of assistant. He laid a broad foundation for his future studies in entomology, and in a paper published in 1863, under the title "Synthetic Types in Insects," he introduced new views into the classification of these forms. From that date to the present time not a year has passed without numerous articles from his pen, a mere list of which would occupy more space than can be devoted to this sketch.

At the same time that he was studying zoölogy he was reading medicine and attending lectures during the winter term at the medical school connected with his Alma Mater, where in 1864 he passed the necessary examinations and received his doctor's degree. In the summer of the same year he set sail again for Labrador, this time in company with the marine artist Bradford, to collect materials for a memoir of the geology and natural history of that then little-known region. On his former trip he had visited only the southern portion of the coast. This time he went as far north as Hopedale, dredging at favorable localities along the shore, and everywhere paying attention to the geology and especially to the former traces of glacial action.

The results of this trip were not, however, to be immediately worked up, for on his return to Brunswick he enlisted for three years as assistant surgeon in the First Regiment of Maine Veteran Volunteers, and marched away to join the Army of the Potomac. While in Virginia the scientific passion ruled strong, and many an insect fell a victim to the collecting-bottle. Fortunately, before the three years for which he enlisted were over, the war came to an end, and Dr. Packard was mustered out in July, 1865, after a military and medical experience of ten months.

He now returned to Boston, and for a while acted as librarian and custodian at the Boston Society of Natural History, at the same time working up the results of his Labrador explorations, which were published as a memoir by the Boston Society of Natural History in 1867, and which still remain the chief source of our knowledge of the fauna and geology of that region. The stay in Boston was, however, of short duration, for at this time the Essex Institute, at Salem, Mass., was displaying great activity in the line of natural history, and negotiations were in progress with the London banker, George Peabody, looking toward an endowment for science in Essex County. These plans rapidly

took such shape that the Institute thought it advisable to increase its scientific force, and so in 1866 it called to Salem four of the students mentioned in the opening paragraph—Packard, Putnam, Morse, and Hyatt—as curators of the Institute collections. These plans, however, took a different turn from that expected by some, and the result was an independent institution, the Peabody Academy of Science, with an endowment of $140,000. The Institute turned over its collections to the new corporation, and with them went the four curators. They retained their connections with the Academy for varying lengths of time. Prof. Hyatt was the first to leave, as he was offered the position of custodian of the Boston Society of Natural History. Prof. Morse left next, and went to Bowdoin College as Professor of Zoölogy. Prof. Putnam, in 1876, was appointed Curator of the Peabody Museum of Archæology and Ethnology at Cambridge, another institution which owed its existence to the liberality of Mr. Peabody. Dr. Packard retained his connection with the Peabody Academy of Science until 1878, when he resigned to accept the professorship of Zoölogy and Geology in Brown University, a position which he holds to the present time.

These twelve years at Salem were prolific in work, only a small fraction of which can be noticed. Possibly the most important service done American science was the foundation of the "American Naturalist," a popular magazine of natural history, by Messrs. Packard, Morse, Hyatt, and Putnam, in 1867. With this journal Dr. Packard was connected, a part of the time as sole editor, for twenty years, only severing his connection with it in the beginning of the year 1887. It is difficult to overestimate the value of Dr. Packard's editorial labors, and it is certainly safe to say that if we consider this point alone no one has done more to shape American zoölogical science than he. Dr. Packard, however, did other work. He had continually several irons in the fire. Entomology was his chosen field, and, perceiving the lack of any manual for students in this department of science, he published in 1869 the first edition of his well-known "Guide to the Study of Insects," a volume which to this day is without a rival. It may be said, parenthetically, that Dr. Packard is now engaged in completely rewriting this work so that it may adequately represent the entomological science of the present time. The same years also witnessed the publication of various systematic and embryological papers, the principal one of which was an account of the development of that ancient form, the horseshoe crab.

The old spirit of exploration was not extinct. Scarcely a year passed without a trip to some point near or remote, the features of which he wished to study. In the winter of 1869–'70 he vis-

ited Key West and the Tortugas for the purpose of studying a tropical marine fauna, and from which he brought back large collections of marine invertebrates to swell the museum of the Peabody Academy of Science. On his return he stopped for a while at Beaufort, N. C., since made so celebrated as a zoölogical center by the labors of Dr. Brooks and his students, but which at that time was scarcely known. The next winter another Southern trip was taken—this time to Charleston, S. C., where some weeks were spent in the study of marine embryology, the results of which are still almost entirely in manuscript.

As is well known, a large proportion of the animals and plants of the United States were first scientifically described in Europe from specimens sent from here there by early collectors. The specimens which form the basis of these descriptions ("types" they are called) are scrupulously preserved in the museums, and it often becomes necessary for the naturalist to consult them to ascertain exactly what species some previous student had before him when he wrote the description which is not sufficient to identify the species. So Dr. Packard found it necessary to visit Europe, in 1872, to see for himself the insects described by the older European entomologists, and the result of the trip was considerable changes in the names of many of our butterflies and moths, for, according to the rules of zoölogical nomenclature, the first name applied to a species is the name that must hold. All the changes which prove so vexatious to the beginner, and for which it is not always easy to see the reason, are but steps toward permanence. By and by each species will be known by the name first given it, and then there will be no more of that tossing from pillar to post.

During the years 1871–1873 Dr. Packard held the position of State Entomologist of Massachusetts, and lectured at both the Maine and Massachusetts Agricultural Colleges upon the subject of economic entomology; but as these positions were very economically managed by the States, and were offices of honor rather than profit, they were resigned the latter year. In 1871 and 1872 he had written a small book in connection with Prof. Putnam upon the animals found in the Mammoth Cave, and then laid the foundation for that interest in the origin and effects of cave-life which is soon to come to fruition in an extensive memoir on the subject. As a result of this book he was appointed an assistant, in 1874, on the Kentucky Geological Survey, then under the charge of his former fellow-student, Prof. Shaler, and directed to make a thorough exploration of the Kentucky caves. The next two years he held the position of assistant zoölogist on the United States Geological and Geographical Survey of the Territories, under the charge of Prof. F. V. Hayden, and in that

capacity visited several of the Western Territories, and published a large quarto memoir on the family of geometrid moths, familiar examples of which are those forms the larvæ of which are known as canker-worms.

The year 1873 witnessed the establishment of the Anderson School of Natural History on the illy adapted island of Penikese, and here for two summers (the whole period of the existence of the school) Dr. Packard gave the instruction in the articulates. When the Penikese experiment was abandoned, the idea of a summer zoölogical station where students could come for the summer and pursue a course of study was taken up by the Peabody Academy of Science, which for five years maintained such a school. During the first three years of the existence of this Salem school (1876–'78) Dr. Packard was at its head, giving lectures, assisting in demonstrations, and in every way trying to make it a success.

The years from 1873 to 1876 will long be remembered by the inhabitants west of the Mississippi, from the terrible devastations of the Rocky Mountain locust, or grasshopper, as it is more familiarly known. Over enormous tracts of country everything green was devoured by these insect pests, and an enormous amount of suffering was caused by the destruction of the crops of the farmers. Indeed, so serious were the ravages that Congress was implored to create a commission of eminent entomologists to seek some way to check the locusts and to prevent their ravages. Congress passed the desired bill, and the Secretary of the Interior appointed, as the United States Entomological Commission, Prof. C. V. Riley, Prof. Cyrus Thomas, and Dr. A. S. Packard. If the logic of *post hoc, ergo propter hoc*, be valid, no better appointments could have been made, for the very year these persons began their duties the locust troubles were very materially diminished. The three members of the commission divided the field between them, and Dr. Packard made several trips to the Territories to study the extent of the locust ravages, and to ascertain their breeding-grounds. One of these trips took him to California, Oregon, and Washington Territory. As has been said, the locust invasions ceased almost the moment the commissioners were appointed, but other insects became serious pests in other parts of the country, and so Congress enlarged the scope of the commission, and directed its members to investigate the chinch-bug, the Hessian fly, and the cotton-worm, and limited the duration of the existence of the board to five years. The commission have published three annual reports, large octavo volumes, filled with information regarding various destructive insects, besides numerous smaller bulletins. They have another and final report now in press.

In 1878 Dr. Packard received the appointment of Professor of Zoölogy and Geology in Brown University, at Providence, R. I., a position which he holds at the present time. Here, besides his duties as teacher, he has found time to conduct various investigations, besides writing three text-books of zoölogy, all of which have met with an extensive sale. In the spring of 1885 he found time to take an extensive trip through the Southern States and Mexico, "doing" the latter country in a manner not common since the completion of the Mexican Central Railway. He cut loose from the steam-horse and trusted himself to the old-fashioned diligence, traveling thus across the country in a more leisurely manner, and seeing far more of it and of its inhabitants than can be seen by the ordinary excursionist from the window of a railway-car.

In 1867 Dr. Packard was married to Elizabeth Derby, the daughter of the late Samuel B. Walcott, of Salem, Mass. He has four children.

Such in outline is the life of Prof. Packard. Of his writings we have said but little, chiefly from inability to choose from their number. That their merit has been recognized by scientific men is shown by the numbers of societies which have conferred the distinction of honorary membership upon him. A complete bibliography of his writings has recently been prepared; but, in addition to those already mentioned in the present article, we may call attention to a few of the more prominent works. In 1873 and 1876 respectively he published "Our Common Insects" and "Half-Hours with Insects," two popular works on entomology. In the latter year he also published "Life Histories of Animals," which was the first compendium of all the known facts in the development of the animal kingdom, a work which has, however, been largely superseded by the more extensive "Comparative Embryology" of the late Prof. F. M. Balfour. In 1883 appeared his monograph of the "Phyllopod Crustacea," an account of a small group of animals which reach their greatest development in America. For several years he contributed the zoölogical notes to the scientific departments of "Harper's New Monthly Magazine," and of the "New York Independent." Of late years his studies have taken a turn in the line of the philosophy of zoölogy rather than in that of the description of species and the identification of specimens. He is now more interested in the structure and growth of animals, and the principles which underlie their distribution in space, than in the details of museum work.

Personally, Dr. Packard is a very pleasant and entertaining companion, and not least among his good qualities is the interest he takes in all who show any predilection toward scientific work.

These he is always ready to assist and encourage to the extent of his ability. As will be seen from the foregoing sketch, he is an indefatigable worker, and, to the brief notices of his articles given above, space will only allow a few other references to the discoveries he has made and the theories he has advanced in the various lines of zoölogical and geological research.

When Agassiz came to this country, he brought with him not only an interest in zoölogical subjects, but, as well, that enthusiasm which made his name famous in connection with the study of glaciers. He pointed out the existence of local glaciers in the White Mountains, but Dr. Packard traced out further than ever before the extent of this local system, following these rivers of ice from Mount Washington and the adjacent peaks down the valleys of western Maine. This work on glaciers was still further elaborated in his large memoir on Labrador, mentioned above, and led to other speculations of a zoölogical rather than of a purely geological character.

These were that the existing insect fauna of at least the Northeastern United States had its origin from a circumpolar Tertiary fauna. The facts for this conclusion were in part the following: Oswald Heer and Dr. Asa Gray had conclusively shown that the plants of the same region had thus originated, the Tertiary rocks of Greenland containing many genera which are characteristic of the American flora of to-day. Now, as is well known, there is the most intimate connection between the distribution of many insects and the plants on which they feed, and the habitats of many insects can only be accounted for upon some such supposition. For these in detail the student should seek Dr. Packard's "Monograph of the Geometrid Moths," but we can mention one instance. Certain butterflies and moths are known to-day only from the colder regions. They are found in Labrador and farther north, while in the United States they only occur in the widely separated mountain-regions of New Hampshire and Colorado. These, it is assumed, must have lived near the edge of the great continental ice-sheet of glacial times, and must have occurred in all the intervening extent of country. As the ice retreated and the territory became warmer, the plants on which the larvæ fed could only find conditions favorable to their existence on these high mountain-regions or the isothermal but lower lands of Labrador. This view of the origin of the fauna of the United States has since been adopted by many writers, and receives its most complete exposition in Dr. A. R. Wallace's "Geographical Distribution of Animals," but without credit to Dr. Packard, who advanced it several years before.

In morphological work, the studies on the development of the sting of the bee must be mentioned. Dr. Packard pointed out

twenty years ago—Dr. Kraepelin has since worked over the subject—that the sting of the bees and wasps is an organ composed of modified limbs, and is to be regarded as homologous with the organs which, in other insects, are devoted solely to reproductive functions. These points he carried out so that he could trace every portion of the one in the physiologically very different organ of the other.

The last of the studies which we can allude to are those of the development of *Limulus*. Dr. Lockwood, the first to study the subject, pointed out the similarity of the young horseshoe crab to the trilobites, and this Dr. Packard elaborated in his more extensive paper. His studies in this direction led him to investigate the ancestry of the king-crab, and he now has in press an extensive memoir on the fossil king-crabs, in which the subject will receive still further treatment, and will, no doubt, present many new views based upon the study of extensive suites of specimens.

Lives like this of Dr. Packard are of interest, not only in themselves, but as instances of heredity. Dr. Packard's father was a man of mark, as every graduate of Bowdoin will testify; while his grandfather Packard — a Revolutionary soldier — was a graduate of and a tutor in Harvard College. His maternal grandfather was the Rev. Dr. Appleton, formerly President of Bowdoin College. With such an ancestry, is it to be wondered that three of the sons should rise to eminence as college professors, while the fourth should become a prominent physician?

EDITOR'S TABLE.

CONGRESS AND INTERNATIONAL COPYRIGHT.

IF it were charged that under our system of government measures of interest to the whole people, particularly such as might chiefly concern their intellectual and moral welfare, were apt to receive less attention from the Legislature than measures of purely local concern, we fear that the action of Congress up to the present in the matter of international copyright might be cited as a striking case in point. For many years past the thinking men of the country, those who give it its intellectual standing among the nations of the world, have been urging the necessity, both as a matter of national self-respect and also as one vitally affecting our intellectual growth, of the enactment of an international copyright law. Congress, however, in its zeal for "appropriations" and for party strategy, saw nothing in this demand to commend it to any special attention. On the contrary, the question raised was not one that seemed to come at all within the range of practical politics. Had the promoters represented one party in the state, and had they been able to show that they were organized for effective party warfare, they would have got a respectful hearing at least from the side they supported. But no; they

belonged to both parties, and some of them perhaps had the audacity to belong to neither, and in general they were not conspicuous in the caucus or famous for their knowledge of ropes and wires. They were simply American citizens, eminent for character and ability, pleading a cause in which not they alone but the whole people were concerned, and in which, so far as they themselves were personally interested, they had a case as strong as justice and common sense could make it. All this availed but little to conquer the indifference of Congress to a proposition that could not be expressed in terms of "politics."

There was a little more than indifference in it, however. The proposition was that this country should cease to appropriate without compensation the literary goods of foreigners, particularly of the British; and this did not fall in with those considerations of expediency which are so likely to influence the attitude of our legislators toward moral questions. How could the representative excuse himself to his constituents for making anything dear in the interest merely of abstract justice and of the higher intellectual development of the country at large? It was also the case that certain organized interests were arrayed against the principle of international copyright. There was no little opposition to it among publishers, printers, stereotypers, engravers, etc., who thought they saw in it the threat of a serious diminution of business. It is no wonder, therefore, that Congress should have put the matter off from year to year; the only wonder, indeed, is that those who believed in the principle should have had the courage to go on and should now by dint of patient persistence be in a position to present to Congress a stronger case than ever—one that can only be put aside through the most extreme and culpable indifference to an issue which affects, not the balance of parties, but the higher life of the whole people.

As the matter stands now, there is substantially but one opinion among publishers and authors in regard to the copyright question. The consideration of justice to foreign authors remains, of course, as before, neither stronger nor weaker; but careful reflection has led the great majority of those interested in the publishing trade to see that, in this case, justice to the foreigner means advantage to themselves. The stimulus that would be given to domestic literary production by the granting of copyright to American editions of foreign works would admittedly be very great; and, as the author can do nothing without the printer and publisher, these would share the benefit with him. There are bills now before both houses of Congress—the House bill being a copy of that introduced into the Senate by Senator Chace, of Rhode Island—providing for the extension of copyright privileges to foreigners on condition that the work for which the privilege is sought is published simultaneously in the United States and in the country of origin. Proof of publication will be the filing of two copies of the best American edition of the work in the office of the Librarian of Congress. Upon the granting of copyright to a foreign work, the importation of all foreign editions of the work in question, save with the consent of the holder of the copyright, is interdicted. These are the principal provisions of the measure, and it will be seen that they do justice to all interests concerned. They also appear to commend themselves to those members of Congress who have given the subject most attention, as the committees of both Houses having the matter in charge reported, without a dissenting voice, in favor of the bill. Congress, therefore, has now an opportunity of doing the country a triple service: 1. Removing the stigma which attaches to the

United States as the sole country claiming to be civilized which disregards the proprietary rights of foreign authors. 2. Greatly extending and improving the field for native authorship. 3. As the result of the two preceding benefits, raising the moral and intellectual tone more or less of the whole people. We may add, as a fourth benefit, the placing of the whole publishing trade of the country on a sounder footing.

The Popular Science Monthly has, from the first, placed itself on the right side of this question by consistently contending for the principle of international copyright, and that without any such reserves in regard to magazine literature as some members of Congress are now disposed to make, and such as it might be supposed to be in the interest of a periodical reprinting more or less from foreign sources might be thought to favor. Our interest in the subject, therefore, is not new-born, but is merely the continuation of that we have both felt and expressed whenever the question has been prominently before the public. In supporting the bill now before Congress, we do not wish to be understood as claiming that it is a perfect measure, or that it may not, after some experience of its working, be found to need amendment. All that can fairly be asked of a new law is that it should affirm a sound principle, and should provide the means for carrying that principle into more or less effective and satisfactory operation. This, however, may be claimed for the Copyright Bill—that it is no hole or corner measure, no product of selfish machinations against the general interest, but that all it aims at is for the public good.

MATTHEW ARNOLD.

MATTHEW ARNOLD, though pre-eminently a man of letters, was one who in many points occupied common ground with the men of science. He had that openness of spirit and that constant desire to search out causes which are among the best characteristics of the scientific temper. He had turned aside as completely from catastrophism in human history as modern geologists have done in regard to the physical history of the globe, or modern biologists in regard to the development of life. He may at times have weaved rather fanciful theories of his own, but he was always willing to bring them to the tests of fact and logic. Though not lacking in self-confidence, he was far from being dogmatic, and he invariably treated opponents not only with respect, but with unfailing kindliness. He had, perhaps, an inadequate appreciation of the value of certain lines of scientific investigation, and, conversely, he may have formed an exaggerated estimate of the value of the literary element in education; but every man must be allowed, as the French say, to preach his own saint; and Matthew Arnold's preaching had always something instructive in it. No man, it is almost needless to say, could write more interestingly than he; and this was doubtless because, with his fine gifts, he took life seriously, and applied his mind earnestly to some of its greatest problems. Allowing for all deficiencies and for a few mannerisms, he was a sound and wholesome thinker, and a useful man in his generation. There can be no doubt that, in his own way, he powerfully aided the great scientific movement of the age. No mind that fell under Matthew Arnold's influence could be closed against scientific conceptions, or could to any serious extent undervalue the work of science; and many must have owed to his vivacious pen their first realization of the extent to which modern thought had invaded and dismantled the fortresses of ancient prejudice. By his poetry, too, he succeeded, perhaps without intending it, in showing that modern thought is not destitute of the instinct for beauty, and that it lends itself in an especial manner to the delineation of the beauty of righteousness. We are not sure that

any poet of our time has spoken so directly to the consciences of the more enlightened portion of his contemporaries as Matthew Arnold. If, as the Roman poet has said, "there are tears in things," so also are there deep and grave admonitions, earnest pleadings, ever a voice for those who will hear, calling to man to walk in the light and realize the bliss of moral freedom. Mr. Arnold has made himself the interpreter to us of the truth of things, and this is what gives his poetry its acknowledged weight and value despite its somewhat restricted imaginative range. To read it is to commune with Nature, not with human authority. Carlyle talks of the "eternities" and "immensities." Mr. Arnold does not talk of them, but he brings us into their presence—

"The world that was e'er I was born,
The world that lasts when I am dead."

In his "Empedocles on Etna," written before he was thirty years of age, Mr. Arnold may be said to have sketched a scientific philosophy of life. We are tempted to quote a verse or two:

"In vain our pent wills fret,
And would the world subdue.
Limits we did not set
Condition all we do;
Born into life we are, and life must be our mold.

"Born into life!—man grows
Forth from his parents' stem,
And blends their bloods, as those
Of theirs are blent in them;
So each new man strikes root into a far fore-time.

. . . . . .

"The world's course proves the terms
On which man wins content;
Reason the proof confirms—
We spurn it, and invent
A false course for the world and for ourselves false powers.

. . . . . .

"I say: Fear not! Life still
Leaves human effort scope.
But, since life teems with ill,
Nurse no extravagant hope;
Because thou must not dream, thou need'st not then despair!"

The world has lost in Mr. Arnold a man ever loyal to the cause of truth, and ever interested in the cause of humanity. We may sometimes have been tempted to regard him as an opponent of scientific discipline; but upon a general review of his career we are compelled to recognize him as an ally, not an adversary, and as one who, just because he cultivated a special field of his own by methods of his own, will not easily be replaced. All the more, then, must we value, as elements of progress, the spirit that breathes through his works and the influence bequeathed by his character.

LITERARY NOTICES.

THE RELIGIOUS SENTIMENTS OF THE HUMAN MIND. By DANIEL GREENLEAF THOMPSON, author of "A System of Psychology," "The Problem of Evil," etc. London and New York: Longmans, Green & Co., 1888.

In the volume before us, Mr. Thompson has entered upon a fruitful field of thought and discussion—one, moreover, which requires great tact and delicacy in its cultivation if the author would secure the sympathetic and respectful attention of his readers. In this respect Mr. Thompson has been notably successful. His treatment of his topic is calm, temperate, philosophical, free from bias, appealing to reason rather than to theological or anti-theological prejudices. While his discussion of the religious problem is entirely frank, manly, and unconventional, it is also duly considerate of those conceptions which he is compelled to discredit and oppose. Some of his conclusions will, nevertheless, probably surprise not only those who are conservative adherents of the Christian faith, but also those who have accepted agnostic or radical views.

Our author defines religion as "the aggregate of those sentiments in the human mind arising in connection with the relations assumed to subsist between the order of Nature (inclusive of the observer) and a postulated supernatural." His use of the term "supernatural" appears somewhat misleading, on account of the character of the antithesis popularly assumed to subsist

between "Nature" and the "supernatural." By the "supernatural" is commonly understood a region beyond the visible universe of law, peopled by arbitrary intelligences which may descend into the natural order, and interrupt its sequence, either for good or for ill. Mr. Thompson's "supernatural," on the contrary, is clearly neither more nor less than the philosophical "unknowable"—the ultimate mystery lying behind phenomena, the only possible knowledge of which is a negative apprehension.

We might question also whether this definition is sufficiently inclusive. How, for example, can Mr. Thompson consistently assign a religious character to positivism, which finds its object of worship wholly within the natural order of the world; or to Dr. Abbot's "scientific theism," which rejects not only the popular notion of the supernatural, but also the Spencerian "unknowable," basing its worship upon the knowledge of an infinitely relational and absolutely knowable universe? Mr. Thompson, indeed, apparently recognizes positivism as "the religion of social immortality," asserting that "the doctrine of deity characteristically belonging to this system of belief is essentially pantheistic." Comteism, however, expressly repudiates all cosmic implications in the object of its worship—its *Grand Être* being simply organic humanity. Even pantheism, as limited to the Cosmos, does not imply supernaturalism. Rather, as in the words of Goethe, it repudiates it:

> "What were the God who sat outside to scan
> The spheres that 'neath his finger circling ran?
> God dwells within, and moves the world and molds,
> Himself and Nature in one form infolds."

Mr. Thompson argues, indeed, with great acuteness and force, that "a postulated supernatural is conditional for all knowledge whatsoever." Those who accept his psychology will doubtless assent to this statement. A primary definition of religion, however, it would appear to us, should be broad enough to cover all philosophical theories.

Parts I and II ("Religion and Religious Sentiments," and "Religious Sentiments in Relation to Knowledge") are devoted chiefly to definition, preliminary explanation, and the development of the psychological basis of the argument. As this has been treated *in extenso* in the author's "System of Psychology," it does not call for special elucidation here. Throughout life, he argues, the *ego* perceives that its activity is necessarily limited. Beyond the limit the consciousness posits a somewhat which is real, yet incomprehensible. Thus arises the idea of the supernatural (unknowable). To the questions why? whence? and whither? which it suggests, we can find no adequate solution. Attempting to make the supernatural the object of thought, we find that we can only do so by ascribing to it the attributes of Nature. Thus, we form symbolical notions of it which vary with changing conditions of mental development. So arise anthropomorphic conceptions of supernatural beings, ideas of heaven and hell, the assumed connection of supernatural intelligences with natural phenomena, etc. This belief in supernatural interference induces fear, impels worship, and influences conduct.

Our author ranks polytheism above monotheism as an incentive to intellectual and social progress. The latter is autocratic and subverts the individual judgment. The former, aristocratic in its nature, stimulates thought and encourages literature and art. Christianity, with its Trinity and angelic hierarchy, he regards as a polytheistic rather than a monotheistic faith. Pantheism is democratic, and favors the free development of the individual reason. Between these different conceptions of the supernatural, truth furnishes no criterion of judgment. We can affirm of neither of them anything more than its probability.

In the chapter on "The Continuity of Personality," Mr. Thompson argues from scientific and psychological analogies in favor of a future life. Admitting that the subject is beset with difficulties, he inclines to the opinion that "the ground for the assertion of *post-mortem* personal self-consciousness in identity with *ante-mortem* self-consciousness is firmer than the contrary belief." A future life implies social relations, and the hypothesis of the separation of the good from the evil, with the final reclamation of the latter, seems reasonable. Our author furnishes no theories of his own concerning the nature or location of the supernatural world. In Part III ("Religious

Sentiments in Relation to Feeling and Conduct") he recognizes the belief in a future life as favoring high ideal ends, while disbelief depresses the mental energies, and fosters selfish enjoyments at the expense of social activities. He condemns theological organizations which condition their fellowship on the acceptance of creeds, and commends the constitution of the Free Religious Association as the best platform for a religious organization. "An æsthetic worship guided by truth" is, he thinks, a benefit to the human race.

The final chapters on "The Education of the Religious Sentiment" have already appeared, in substance, in "The Popular Science Monthly." They present strong arguments for unpartisan scientific instruction in the history of religions, and the complete secularization of our public schools as the fairest and most practicable means of preserving their integrity and usefulness. The book, as a whole, stimulates thought and holds the attention of the reader. In connection with "A System of Psychology" and "The Problem of Evil," it justifies us in ranking its author among our ablest philosophical thinkers.

THE COUNTING-OUT RHYMES OF CHILDREN: THEIR ANTIQUITY, ORIGIN, AND WIDE DISTRIBUTION. A Study in Folk-Lore. By HENRY CARRINGTON BOLTON. London and New York: D. Appleton & Co. 1888. Square 8vo. Pp. xii–123. Price, $2.50.

IN this handsomely-printed volume the author has collected a large number of the curious doggerels used by children in counting-out for the purpose of determining who shall be *it* in certain games. He details the customs as practiced in Great Britain and America, and gives many examples, such as—

"One-erzoll two-erzoll zick-erzoll zan,
Bobtail vinegar, tickle 'em tan;
Harum squarum, virgin marum,
Zinctum, zanctum, buck!"

The author then shows that children of all civilized and semi-civilized races have similar practices, and repeat doggerels with common characteristics; examples are given in twenty languages, including Japanese, Hawaii, Marâthi, Arabic, Turkish, Bulgarian, Basque, and all the modern languages of Europe. The collection of rhymes numbers nearly nine hundred, of which about four hundred and seventy-five are in English. This wide distribution of the process of counting-out, and the fact that in all languages certain features of the doggerels are common, point to great antiquity for the custom, which, the author claims, originated in the superstitious practice of divination by lot—sortilege. This view is borne out by many analogies between ancient methods of divination and the existing children's games. One chapter treats of conjurations, exorcisms, and charms current in early times; another discusses the question whether these rhymes are derived from Latin prayers, and points out the extraordinary literary fraud perpetrated in 1840 by John Bellender Ker. In another chapter the author shows that, to a certain extent, the changes in English rhymes are influenced by geographical environment. In a few instances the exact date at which a given doggerel was composed can be ascertained by its local coloring. The marked influence of German immigration in America is manifest in even these children's rhymes, many of which are of German origin; for example—

"Ana, mana, bona, mike,
Barcelona, bona, strike,
Care, ware, frow, frack,
Hallico, ballico, wee, wo, wack!"

This undergoes a great many variations. A brief chapter relates to the Anglo-Cymric Score, and the second part of the work contains eight hundred and seventy-seven rhymes grouped under the various languages. The material for this volume was gathered by correspondence, and orally; the sources of the rhymes are indicated in nearly every instance by the initials of the contributors. A bibliography of the works consulted is one feature of the work, which is the first to appear on the subject of folk-lore since the establishment of the Society of American Folk-Lore. The volume appeals to all who recall the happy hours of their childhood. Several English literary papers have announced this work as written by *Mrs.* Carrington Bolton—an absurd blunder. The author is known by his publications on chemistry and bibliography, and was professor in Trinity College, Hartford, for many years.

DISEASES OF MAN: DATA OF THEIR NOMENCLATURE, CLASSIFICATION, AND GENESIS. By JOHN W. S. GOULEY, M. D. New York: J. H. Vail & Co. Pp. 412.

THE author's purpose in preparing this book has been to urge the official adoption of a stable basis for the nomenclature and classification of disease; to advance some propositions that may contribute to that end; and to call attention to the improprieties evident in the present unsystematic nomenclature, with a view to enforcing the need of reform. The book is, in short, offered as "a plea for the more systematic study of diseases, and as an individual protest against their existing nomenclature and classification, with the hope that this protest will become general among teachers and others, who realize the necessity of bettering the condition of medicine, without undertaking to destroy its fabric in order to reconstruct it; but rather to modify, simplify, and improve it by gradually substituting exact terms for those which have never conveyed correct ideas." While it is easy to attach an exaggerated importance to mere names, it is evident that a philosophical nomenclature, based upon the real and ascertained principles of the science to which it is to be applied, is a great aid to the understanding of that science and to forwarding its advance. But the practical difficulty arises in every science, and every nomenclature, that names have to be found and used before it is possible correctly to determine the principles. In this fact, which is unavoidable, unless we would carry on our science without words, we find the origin of the anomalies in names—the wrong names and the unmeaning names—of which Dr. Gouley complains, and which he makes this effort to correct. He recognizes the nature of the evil, and, while anxious to find a remedy and apply it, does not overlook the importance of acting prudently upon the matter. Therefore he says: "Conservatism is praiseworthy when applied to words that have stood the test of years, and are still adjudged good and proper. Those time-honored terms which convey ideas with precision should be jealously preserved; but that multitude of misleading expressions, to be found in the literature of medicine, should be speedily blotted out of coming medical treatises and dictionaries, and their places filled with well-chosen and philologically correct words." True to the spirit thus exhibited, he does not so much suggest a new set of names, although that point is not overlooked, as he discusses the principles on which the classification of diseases and their nomenclature should be based. With the discussion are embodied reviews of the various systems of classification that have been introduced to the profession by its most eminent representatives of all ages, from Hippocrates down to Broca. The final conclusion is reached that any system of nosography, to be of utility to those whom it concerns, should be the result of the conjoint labors of the medical profession of all the civilized nations.

REPORT OF THE COMMISSIONER OF EDUCATION FOR THE YEAR 1885–'86. N. H. R. DAWSON, Commissioner. Washington: Bureau of Education. Pp. 21 + 792.

THIS report has been prepared by N. H. R. Dawson, who was appointed commissioner soon after the close of the year which it covers. The new commissioner determined, after the completion of the report for 1884–'85, which was still in hand, to concentrate the work of his force upon the preparation of the present volume, so that this and future reports might appear more promptly than previous issues have. The result has been that, while the preceding volume was distributed twenty-two months after the end of the year which it covers, the report for 1885–'86 has not been so long delayed by three months. This is a commendable change, for many of our Government reports lose much of their value by delay in preparing and publishing them. Mr. Dawson has also revised the plan of the reports, with a view of further facilitating prompt preparation and early printing of the document. The nature of the change is "to avoid repetitions, to omit unimportant items, to consolidate related but hitherto separated facts, and to unite the discussion of statistical conditions with the tabular statements wherein they appear." The appendices contain the usual statistics thus modified in form. Appendix I deals with State school systems. Its statistical tables are followed by a *résumé* of the general condition of public schools in the several States and Terri-

tories, drawn chiefly from the printed reports of the superintendents thereof, and it concludes with an abstract of the public-school laws of each State and Territory. A later appendix contains the report of the General Agent of Education in Alaska for the year 1886–'87. Among the subjects to which the commissioner directs attention are the purpose and condition of secondary instruction, the need to professional students of a previous liberal course of study, and the value of manual training in its influence on the mind.

THE AMERICAN GEOLOGIST. Vol. I, No. 1. January, 1888. Minneapolis. Monthly. Price, $3 a year.

THE geologists of America are to be congratulated that their branch of science now has its special journal in this country. This magazine, it is announced, will be devoted to geology in its widest sense. "It will include, therefore, within the scope of its discussions and contributions all the sciences that are kindred, and that contribute by their more special investigations, to the general science of geology. It will hence serve as a medium of intelligence to the stratigrapher, the petrographer, the paleontologist, the mineralogist, the fossil botanist, the climatologist, the chemist, the physicist, the seismologist, the glacialist, the anthropologist, and the astronomer, in all those directions where their special investigations bear directly upon the constitution and history of the globe." The "Geologist" will also make a special effort to aid the teacher of geology, both by suggesting methods of instruction, and by furnishing new facts and illustrations. It will urge co-operation and organization among geologists, and will aim to preserve and increase that general interest in geological science which supports both private and national investigations. The editors and proprietors are Prof. Samuel Calvin, Prof. Edward W. Claypole, Dr. Persifor Frazer, Prof. L. E. Hicks, E. O. Ulrich, Dr. A. Winchell, and Prof. N. H. Winchell. The first number contains six short articles, an editorial on "Geology in the Educational Struggle for Existence," and another reviewing "Irving and Chamberlin on the Lake Superior Sandstones." There are also departments for book-notices, and for personal and scientific news. It must be confessed that the "Geologist" starts out with a somewhat sectional aspect—only one of its seven editors residing east of Ohio, and only one of the six body articles in this number, that on the International Congress, dealing with anything but Western formations. The latter feature, at least, should be corrected in future numbers.

THE MOVEMENTS OF THE EARTH. By J. NORMAN LOCKYER, F. R. S. London and New York: Macmillan & Co. Pp. 130. Price, paper, 60 cents.

IN this little volume the author has presented a general view of that part of astronomy relating to the planet on which we live. The first chapter deals with methods and instruments for measuring angular space, and is followed by a chapter on the measurement of time. The rotation of the earth, the earth's revolution, and the conditions of its revolution, are successively described, and the closing chapter is devoted to such results of rotation and revolution as the succession of day and night and of the seasons, precession and nutation, etc. The style of the book is clear and popular, though without special effort to be entertaining. The author intends to follow this volume with others, dealing with other celestial bodies.

FOOD-ADULTERATION AND ITS DETECTION. By JESSE P. BATTERSHALL, Ph. D., F. C. S. New York and London: E. and F. N. Spon. Pp. 328. Price, $3.50.

THE public has at least partly awakened to the dangers which the avarice of dishonest dealers in food-products is spreading around it more thickly than ever before, and it is calling upon health-officers, chemists, physicians, and the reputable dealers in these articles for protection. The special scientific knowledge needed by those who stand in this relation to the public is furnished by the present work, which is designed to be a trustworthy guide to the latest and most approved methods of detecting foreign substances in foods and beverages. The articles treated comprise the common infused drinks, dairy products, bread and bread materials, sugar, alcoholic beverages, water, spices, etc., and the tests described are both chemical and microscopical. The volume is illustrated with photomicrographic plates showing the appearance,

under the microscope, of milk, butter, and other fats, starches, spices, and organisms found in water; also with plates representing tea and other leaves and the construction of the polariscope. This work will have a value to American analysts over all previous books on food-adulteration in the respect of being written in this country, and hence giving most attention to the adulterations most practiced here. The latest results attained by our National and State Boards of Health in regard to sophistications of food are also inserted. The appendix comprises a bibliography of the subject, with the full text of the most important laws, and a summary of others, recently enacted in this country for the prevention of food-adulteration. The thoroughness and care with which the subject is presented, together with the valuable character of the illustrations, and the helpful features included in the appendix, make the book well suited for the main dependence of the American food-analyst.

A TREATISE on *The Art of Investing*, by *a New York Broker* (Appleton, 75 cents), is what many people will be glad to have. This little book gives the chances for profit and the risks connected with Government and municipal obligations, railroad and other stocks, mortgages, water-works loans and securities, with hints as to when to buy, and —what many investors never think of— when to sell. There is a chapter on speculating, which furnishes many and strong reasons why the inexperienced should let that form of gambling alone. An appendix contains lists of securities, transcribed from the books of our principal exchanges, showing when each security is payable and the amount issued.

A description of *The Vosbury Tunnel* has been published by *Leo von Rosenberg* (the author, New York, $1), in the form of a handsome, abundantly illustrated pamphlet, of quarto size. This tunnel is located near Tunkhannock, Pa., on one of the lines associated with the Lehigh Valley Railroad. It was completed in June, 1886, and is a trifle less than three fourths of a mile long. The pamphlet describes the surveying work for the tunnel, the method of tunneling and the machinery used, the construction of the arching, and various minor matters. There are also tables of progress in excavation and construction, of brick and cement tests, and of contract prices and wages. The many plans, maps, and views make up a record of experience which will doubtless be of value to all in charge of similar works.

The *History of the Ottawa and Chippewa Indians of Michigan*, by *Andrew J. Blackbird* (the author, Harbor Springs, Mich., $1), is a unique publication. It is written by an educated Indian, whose father was chief of the Ottawas, and comprises, besides a historical sketch of the tribes mentioned, a brief history of the author's life, and a grammar of the Ottawa and Chippewa language. Mr. Blackbird has been a United States interpreter under several Indian agents, and afterward was postmaster at Harbor Springs for eleven years, when, the position having become a desirable one, he was ousted. He is now nearly seventy years old, and in scanty circumstances.

Dr. A. P. Peabody has written a volume of *Harvard Reminiscences* (Ticknor, $1.25), which every one who has been in any way associated with the venerable preacher emeritus, or the university, will welcome. It consists of sketches of the college officers whose names appeared with that of the author in the several annual catalogues in which he was registered as undergraduate, theological student, and tutor. There is also a supplementary chapter describing Harvard College sixty years ago.

Mrs. L. M. Morphead has put together *A Few Incidents in the Life of Prof. James P. Espy* (Clarke & Co.), in order to correct an impression that his early education was neglected, which is given by the statement in Ben: Perley Poore's reminiscences that at the age of seventeen Espy could not read. Had his wife survived him, or had he left any children, we should probably have had a fuller account of the life of the able author of "The Philosophy of Storms."

The Soul, or Rational Psychology of Emanuel Swedenborg, is published by the New Church Board of Publication, New York, in a translation by Mr. Frank Sewall from the Latin edition of Dr. J. F. Immanuel Tafel. It forms the seventh part of the author's great work on "The Animal Kingdom." The position from which Sweden-

borg viewed the world of mind and matter was a peculiar one, and does not correspond with that from which the scientific investigator or even the orthodox Christian of the present day regards it; but all concede, we believe, that he wrote learnedly and honestly, and with thoughts that appeal strongly to certain classes of men. According to the translator, the one desire and aim that animated the entire series of his writings was the "search for the soul." Concerning the scientific bearings of his works, Mr. Sewall declares that they speak "the glorious promise of a reward to be reached higher even than that sought for; of an end whose realization, only blindly striven for in the ascending ladders of knowledge, finally fills and illumines all the subordinate science with a light, a warmth, a beauty inconceivable before. . . . The scientists of the present day, with their careful elaboration of the facts of sensuous knowledge, are building wiser than they know; their own aims, the particular theories they seek to establish, are of minor account—they are the baubles placed before it to induce it to walk"—leading them on, of course, toward the realization of higher discoveries.

Another new language has been constructed, and is described by the inventor, *Elias Molee*, in his *Plea for an Amerikan Language* (the author, Bristol, D. T., $1.25). This language is based on English, rejecting all words not of Germanic origin, and with its spelling made phonetic by the aid of new letters, and its inflections made regular. Vowels have been preferred to consonants for inflectional endings, in order to give the new language more euphony than English has. The author claims that his Amerikan or Germanic-English language has the same excellences as Volapük, and is better adapted for use by the Germanic race.

The *Report of the New York Agricultural Experiment Station for 1887*, *E. L. Sturtevant*, Director, embodies the results of experiments in quite a wide range of subjects. Considerable work on the movements of soil-water and on the cultivation of the potato is reported. This volume contains also descriptions of varieties of twelve important vegetables, with classification, etc., nearly all of the varieties described having been grown at the station more than one season. Many minor topics have also received attention.

Dr. William H. Holcombe's pamphlet entitled *Condensed Thoughts about Christian Science* (Purdy Publishing Company) differs from the common run of expositions of this doctrine in being written in good English, and in showing for its author some ability to think. It presents a fairly clear view of the not very clear theory of "Christian science," or rather the author's interpretation of that theory, for hardly two writers on the subject agree with any closeness.

Fever-Nursing, by *J. C. Wilson* (J. B. Lippincott Company), is one of a series of "Practical Lessons in Nursing," by different authors, published by the same house. It is designed for the use of professional and other nurses, and especially as a textbook for nurses in training. The instructions were first given in courses of lectures given before the nurse class at the Philadelphia Hospital. In them the author has sought to treat the subject in plain words and from the standpoint of the physician, and to teach not only how fever-patients are to be cared for, but why they must be cared for in particular ways.

The *Outlines of Practical Physiology* of Mr. *William Stirling* (P. Blakiston, Son & Co., $2.25) was designed primarily for the use of students in that branch in Owens College, and is now published in the belief that it will be found useful to other students as it has been to them. The peculiar feature of the book, as among students' manuals, is the prominence which is given to actual experimental work. It is, in fact, almost wholly a list and description of experiments, which the reader is expected to perform, according to the directions, for himself. They have been performed by the author in illustration of his lectures, and also by every member of his class. None of them, however, involve the infliction of pain upon living animals.

L'Iodisme (Iodism), by *Elizabeth N. Bradley*, of Dobbs Ferry (G. Steinheil, Paris), embodies in a volume of 168 pages the results of careful studies of the action of iodine upon the system, and the effects it produces

upon the different parts, and under different forms of administration. The author began her experiments for the investigation of the cutaneous eruptions produced by iodine and bromine, but soon found that to form an adequate conception of the etiology of these cases it would be necessary to regard the processes of iodism and bromism in their entity. Then she became convinced that the processes were only a strong accentuation of the symptoms, considered normal of medication, to which little regard had been attached. Thus her investigation gradually became so thorough and far-extending that she was brought to confine it for the present to iodine, leaving bromine to a subsequent research.

Stimulants: Uses, and how best conserved, by *J. M. Emerson* (Dick & Fitzgerald, 50 cents), considers the temperance question from a point of view not usually taken. The author regards alcohol as a natural product, having beneficent uses, and seeks to separate those uses from the abuses of strong liquors and intoxication. While condemning all strong liquors, he holds pure wines to be altogether good, and believes that, with the exception of special cases of uncontrollable inebreism, the use of them tends to limit itself and is entirely safe; and that in their use lies the most effectual method of breaking up the alcoholic habit.

The Invalid's Own Book, by the Honorable Lady *Cust* (Gottsberger, 60 cents), is a collection of brief recipes for preparing a wide variety of dishes and beverages. It includes various teas, waters, milks, gruels, jellies, puddings, soups, breads, sirups, and punches, together with a few kinds of fish and meat.

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POPULAR MISCELLANY.

The Discoverer of Chloroform. — The Jefferson County (N. Y.) Historical Society, having secured the battle-field of Sackett's Harbor, besides erecting a monument to the soldiers buried there, has determined to perpetuate the memory, in a similar way, of Dr. Samuel Guthrie as the discoverer of chloroform. In aid of this object, Mr. O. Guthrie has prepared an account of Dr. Guthrie and his work, in which his claims to the original discovery of chloroform are set forth. Dr. Guthrie was born the son of a practicing physician in Brimfield, Mass., in 1782. He was an examining surgeon in the army during the War of 1812, and established a vinegar-factory at Sackett's Harbor, for supplying the military post there. In 1817 he removed to that place, and prosecuted experiments in the manufacture of powder, which, extending over a period of nearly forty years, were, perhaps, more extensive than those of any other man of his day. The priming-powder—"percussion pill"—made there, is of his invention. He died in 1848. His claim to priority in the discovery of chloroform rests upon his publication, in "Silliman's Journal" for October, 1831, of an article which circumstances indicate to have been written not later than in July of the same year, describing the preparation and properties of a spirituous solution of chloric ether. The ether was prepared by distilling chloride of lime with alcohol. In the article referred to, Dr. Guthrie says: "During the last six months a great number of persons have drunk of the solution of chloric ether in my laboratory, not only very freely, but frequently to the point of intoxication; and, so far as I have observed, it has appeared to be singularly grateful, both to the palate and stomach, producing promptly a lively flow of animal spirits and consequent loquacity, and leaving, after its operation, little of that depression consequent to the use of ardent spirits. This free use of the article has been permitted, in order to ascertain the effect of it in full doses on the healthy subject; and thus to discover, as far as such trials would do, its probable value as a medicine." The subject has been investigated since the publication of Mr. Guthrie's pamphlet, by a committee of the Chicago Medical Society, whose report, we understand, fully substantiates Dr. Guthrie's claim to priority. It appears, in fact, that the account of Dr. Guthrie's process for obtaining chloric ether was in the publisher's hands prior to May 8, 1831; that his chloroform was at the same time in Prof. Silliman's hands for distribution; and that experiments had then been making with the article for six months. This would carry the date of the discovery back into 1830. The claim of Dr. Soubeiran, the Frenchman, is based upon the publication of his account in January, 1832; and Liebig's work upon the subject was, by his own assertion, completed in November, 1831.

Training for Census-Work.—Hon. Carroll D. Wright, Commissioner of the United States Bureau of Labor, in a recently published paper on "The Study of Statistics in American Colleges," says: "I would urge upon the Government of the United States, and upon the governments of the various

States, the necessity of providing by law for the admission of students that have taken scientific courses in statistics as honorary *attachés* of or clerks to be employed in the practical work of statistical offices. This can be very easily done without expenditure by the Government and with the very best economic results. We take a census of the United States every ten years, but, as a rule, the men that are brought into the work know nothing of statistics. They should be trained in the very elementary work of the census-taking and of statistical science. How much more economical for the Government to keep its experienced statisticians busily employed in the interim of census-taking, even if they do no more than study forms, methods, and analyses connected with the presentation of the facts of the preceding census! Money would be saved, results would be more thoroughly appreciated, and problems would be solved."

Plant-Lice and their Insect Enemies.—Two features in the life of plant-lice are the enormous rate at which they multiply, and the suddenness with which they sometimes disappear. The cherry-trees may be black with them in May, and in a month hardly a specimen of them will be found. This welcome riddance is due to their insect enemies. A syphus maggot with a pointed head, says Mr. A. J. Cook, of the Agricultural College, Michigan, just revels in plant-lice. It seems never satiated, and it is hard to understand how so small an insect can make so large a meal. The lady-birds, and especially their larvæ or grubs, do signal service in the same direction. Several species of the genus *Aphidius* of the ichneumon family, very minute parasites, destroy the lice by the thousands. Thus, plant-lice on out-door vegetation, which may threaten dire mischief early in the spring, are almost vanquished before summer comes. In some years, however, probably favored by drought, the plant-lice live out of proportion, and succeed in spite of their enemies, when they do most serious injury. They are sometimes favored, too, by misguided cultivators, who destroy their enemies, mistaking them for mischievous insects. The aphides may be destroyed by the kerosene-and-soap mixture, which consists of a quarter of a pound of hard soap or a quart of soft soap, and a quart of water, heated till the soap is dissolved, to which a pint of kerosene is added, and the whole agitated till a permanent emulsion or mixture is formed. It is applied with a force-pump, of which some are made for the purpose.

Monuments, Sculptures, and Inscriptions at Copan.—Mr. A. P. Maudsley has made a systematic examination of the principal ruins of the ancient city of Copan, in Central America, one of the most interesting of the sites explored and described by Stephens in his first account of his investigations. Mr. Maudsley's examination included surveys and measurements of the mounds, excavations, and the taking of casts, which will be preserved in the South Kensington Museum. He believes that the nature of the structures has been in some points mistaken; that the so-called pyramids are the raised foundations which supported roofed buildings—probably temples—which were approached by steep flights of steps; that the long heaps of stones which were taken to be the ruins of city walls are in fact the remains of single-chambered, stone-roofed houses; and that the great "river-wall" is merely a wall in appearance, resulting from the river having changed its course and eaten into the raised terraces and lofty foundations on the east side of the ruins, the plan of the structure on that side having been originally the same as on the other sides, with slopes and stairways. A few worked stones, including some beads and a whorl of jade, pearls, and carved pieces of shell, a pot containing red powder and several ounces of quicksilver, human bones, dog's teeth, and skeletons of jaguars, parts of one of which were painted red, were found in the excavations. Mr. Maudsley adduces evidence, from the failure of all the Spanish chroniclers to make any mention of the cities which these ruins represent, or of anything like them, and from the comparison of the ruins with what the Spaniards did speak of, that the sites had been deserted, and the buildings buried in the forest and lost, long before the time of the conquest. The ruins of Copan have been famous ever since Stephens made them known, for the profusion of sculptured orna-

ment and hieroglyphics which they bear. In examining them, Mr. Maudsley was struck with the frequency with which the serpent symbol, usually the plumed serpent, is used in the sculptures. It appears in the scroll-work, is often found in connection with a natural or more or less grotesque human head; and occurs under various disguises, in many of which its presence is not revealed at first sight. One of the most interesting points noticed in the inscriptions—which the author believes should be read in double columns, from left to right, and from top to bottom—is that all those which there is reason to believe are complete from the beginning are headed by what might be called an initial scroll, and begin with the same formula, usually extending through six squares of hieroglyphic writing. The sixth square, or sometimes the latter half of the sixth square, is a human face, usually in profile, inclosed in a frame or cartouche, like the names of the kings in Egyptian inscriptions.

Some Old Natural History and Fables.—The "*Speculum Mundi*; or, a Glass representing the Face of the World," which was published in 1670, before the advent of real science, contains some very curious statements in natural history. The bigness of the whales, it says, "equalizeth the Hills and mighty Mountains." Indeed, some authors mention "far greater whales than these." Above all others, mermen and mermaids are considered "the most strange fish in the waters." A fine specimen of mermaid, which was said to have been caught in Holland, "suffered herself to be cloathed, fed with bread, milk, and other meats, and would often strive to steal again into the sea, but, being carefully watched, she could not. Moreover, she learned to spin and perform other petty offices of women; but at the first they cleansed her of the sea-moss which did stick about her." The ostrich is said to be compounded, as it were, of a bird and a beast. For making a drunkard loathe his liquor, a prescription is given for breaking owl's eggs and putting them into it. Birds-of-paradise "have no wings, neither do they fly, but are borne up into the air by the subtility of their plumes, and lightness of their body." The unicorn is described as being like a two-year-old colt, with a horn growing out of his forehead, "a very rich one . . . being a horn of such virtue as is in no beast's horn besides, which, whilst some have gone about to deny, they have secretly blinded the eyes of the world from their full view of the greatness of God's great works." The gorgon is "a fearful and terrible beast to look upon. He causeth his mane to stand upright, and, gaping wide, he sendeth forth a horrible and filthy breath, which infecteth and poysoneth the air." The cockatrice or basilisk is called the king of serpents, not only on account of his size, but also "for his stately pace and magnanimous mind." His poison scorches the grass as if it were burned. The "beams" of his eyes will kill a man. The dragon is found chiefly in India and Ethiopia. "His wings will carry him to seek his prey when and where occasion serveth"; his teeth are very sharp and set like a saw, but his prodigious strength "resteth in his tail." The amphisbena has two heads and no tail, "having a head at both ends." Africa "aboundeth" with them.

Volcanic Lava-Cones.—Professor Dana observes, in connection with studies of the recent eruption of Kilauea, that in external dress the crater of highly viscid lava is very unlike that of the feebly viscid. The cone in the former often rises with slopes of from 30° to 35°; that in the latter often of but from 5° to 10°. The former commonly uses cinders largely in making its cone, or else has the less fusible orthoclase lavas to deal with; the latter is lava-made, cinder deposits being subordinate to those of lava. The crater in one is lengthened upward at the top by cinders, and has crater-cones about each vent of liquid lava within the crater; that in the other is often a broad pit, with a floor of cooled lava, over which are large and small lava-vents, and low, lava-made cones. The volcano of the former kind is more liable to catastrophic eruption, with noisy earth-shocks, though often quiet in some discharges; those of the latter commonly work with comparative quiet, having their large outflows at times without announcements of any kind to those dwelling a few miles away. There are differ-

ences, but they are differences in some of the results of the action going on, not in causes or methods. The first of the two kinds of volcanoes prepares for a new eruption by the gradual filling up of the emptied crater, doing this by means of one or more lava-vents in the bottom, which, besides throwing up cinders, have their little outflows (as well described by Secchi for Vesuvius), and keep at the work until the crater is filled, or nearly so; and then come the break and the greater outflows. The second kind differ only as to the cinders; and in Kilauea, as to the height of the floor before the outbreak. Both from Vesuvius and Kilauea we learn that, next to the lava-vent, the crater of a volcanic mountain is its prime or most fundamental element. It incloses the extremity of a lava-conduit of greater or less breadth that reaches down to the seat of fires; and this inclosure exists because of the ejections by outflows and upthrows of the consequent down-plunges, which superficial conditions in large part determine. The growing mountain-cone can not be rid of its crater except by the gradual disappearance and healing over of the lava-vent; and, commonly, when extinction happens, the crater is still of nearly full size. If half or wholly obliterated, it may be again restored; and is likely to be, if activity is ever renewed in the region by new aggressive action below. If so renewed, it may go forward through refusions and new ingulfment. But the first step may be the opening of the old fissure upon which the crater was originally made; in this way the lava-conduit might secure for itself at once an open way to the surface. It may be that the course of the old fissure has been a chief cause in determining the form of a crater; and it may lead, in after-history, to changes in the locus of the chief vent, or an elongation of the crater in one direction rather than in another.

Water-Pipes of Lead, Tin, and Iron.—On the question of the "Action of Drinking-Water on Lead," Dr. Tidy, Mr. Crookes, and Dr. Odling have reported to the British Association that they deem it impracticable, even though it were advisable, which they doubt, to replace lead pipes by iron pipes, or even by pipes of tinned lead. In tinned-lead pipes the tinning is found not only to be detrimental to the strength of the lead, but to be likely, unless the coating is perfect, to assist the dissolution of the lead. Iron pipes, although strong, and safe so far as health is concerned, are more likely to break, more difficult to adjust and repair, very easy of oxidation, and liable to obstruction from accumulation of the oxide. Tin is also acted upon by water, though its toxic action is below that of lead. It is fairly flexible, but four times as expensive as lead, but a thinner pipe would suffice. There is reason, however, to believe that waters do not afford a protective coating to tin as they do to lead. The advantages of lead service-pipes are their cheapness, durability, and flexibility, and the ease with which they can be wrought and repaired. The authors recommend the systematic and continuous filtration of the water, with such modifications of the filter-bed as will insure its efficient silication. This will, in their belief, minimize and practically prevent the action of the water on the lead surfaces. It would, moreover, improve the brightness and color of the water, and lessen the quantity of organic matter held in solution.

Practical Chemistry in Housekeeping.—The "Popular Science News" notices some facts connected with the preparation of food that illustrate how the housekeeper is in reality a practical chemist. The object of all cooking, or application of heat to the raw material of food, is to bring about changes in the character of certain bodies of complicated organization; and this is often done without producing any difference in composition perceptible to the chemist. Such is the case when albumen is coagulated: we clear coffee with albumen or the white of an egg, through its power of inclosing particles in suspension when it becomes hard. If the coffee-maker uses fish-skin, it performs the same office by forming a kind of leather with the tannin of the coffee. Glue is a coarse, and cooking gelatin a refined form of the same substance, which is insoluble in cold water, but absorbs it, swelling up and becoming soft. When heated with the water, gelatin dissolves, and then, when cooled again, "jells"; but, if boiled too long, it loses the "jell-

ing" quality; the same property of gelatinizing is possessed in fruits by pectine, which is, however, a distinct substance. The stimulating properties of tea and coffee are due to their peculiar alkaloids, theine and caffeine; their flavor, to aromatic substances which are extracted by the hot water from the leaf or berry. Wheat-flour is composed of starch with gluten, and more or less of mineral or inorganic substances. The finer and whiter flours are nearly pure starch, and are not so nutritious as the less attractive brown flours. The raising of dough is a true process of fermentation, precisely similar to that of the brewer or distiller, but the alcohol soon passes away. Sugar, when heated, melts, and is converted into an uncrystallized, pliant mass, known as barley-sugar, or sugar-candy. At a somewhat higher temperature it is decomposed, and a dark-brown substance, known as caramel, is formed. Granulated sugar is seldom adulterated. The term salt, in its technical sense, includes the fats, which are compounds of characteristic acids with glycerin as a base. Upon adding potash or soda, the acid combines with the alkali, forming soap, and the glycerin is set free. If soda is used, hard soap, if potash, soft soap, is formed.

Purification of Sewage by Infiltration.—Filtration of sewage is defined in the report of the Royal Commission on Metropolitan Sewage Discharge to be its concentration, at short intervals, on an area of specially chosen porous ground, as small as will absorb and cleanse it; not excluding vegetation-culture, but making the produce of secondary importance. On a suitable soil, such as a sandy loam with a small proportion of gritty gravel, specially prepared by surface leveling and deep under-drainage, one acre is said to be capable of purifying the sewage of one thousand people, manufacturers' refuse and storm and surface waters excluded. Mr. Bailey Denton, who has had ten years' experience in filtration, and has published a book about it, does not think it necessary, or even, in most cases, desirable, to precipitate the sludge before applying the sewage to the filtration-beds. He does not believe that under proper treatment sludge is capable of clogging the pores of the land or of injuring vegetation. He advises the laying out of the filtration-beds in ridges and furrows, the sewage only to flow into the furrows and not to be allowed to flood the ridges on which plants and vegetables are growing. As soon as the deposit of sludge on the sides of the furrows is sufficient to prevent infiltration in any great degree, the sewage should be withheld from the areas so affected. The sludge should then be allowed to dry partially in the furrows, and when in a fit condition be lifted and dug into the ridges. The slimy matter, which has appeared so considerable and which puddled the bottom of the furrows when wet, shrinks to a skin of very insignificant thickness when dry, and is readily broken up and mixed with the soil. The intermittency of the application of the sewage to the filter-beds is essential. Each bed should have eighteen hours' rest out of the twenty-four, to allow air to follow the pores of the land, and thereby renew the oxidizing properties of the soil. The assimilative power of growing plants is doubtless also a great aid in the purification of sewage. Intermittent filtration is probably, however, likely to have its most useful application in combination with surface or broad irrigation.

The Slavic Feast of St. Nicholas.—The feast of St. Nicholas takes the place, among some of the Slavic peoples, of our Christmas. The chief feature of the festival is the catechization of the children on the eve of the day, for which the good bishop is personated by a youth dressed in long white vestments, with a silk scarf, and furnished with miter and crosier. He is accompanied by two angels, also suitably dressed, and followed by a troop of devils, having blackened visages, horns, pigs' faces, and other ingeniously devised distortions, and all rattling chains. The visitations take place at the houses where the children are gathered in their evening parties. St. Nicholas enters with two angels, while the devils are left outside. He calls up the children one by one, and seriously examines them, with questions suited to their ages, and in their knowledge of prayers and hymns. Those who pass the questioning successfully are rewarded with presents of nuts and apples; those who fail have to stand aside. After

the examinations are completed, the devils are called in, and, while they are not allowed to annoy the good children, they are permitted to tease the naughty ones as much as they like. The performance passes at last into an hour of jollity and romping. The children having returned to their own homes, and said their prayers previously to going to bed, place dishes or baskets upon the window-sills, with their names written within them, for the presents which St. Nicholas is to bring.

Mithraism.—The religion of Mithra, or, rather, ideas and forms connected with it, played an important part in the thought of the early centuries of the Christian era, yet little is known of Mithraism at the present time, and the discussions of it are largely speculative. It has been generally treated as having been a mere form of sun-worship; but that accomplished antiquary, Mr. J. A. Farrer, has expressed the belief that it was at bottom the worship of Ormuzd, the Persian conception of the Deity, which answers exactly to the Jewish conception of Jehovah. While we may never know what its actual rites or mysteries were, it is evident that they enforced a high and severe standard of morality through a symbolism which now seems ridiculous. Candidates for initiation went through some twelve or, perhaps, eighty trials of physical endurance, by fire, water, fasting, etc., in order to present themselves holy and free from passion. They passed through several degrees, and were called, according to their sex or advancement, lions, hyenas, ravens, eagles, and hawks. There were ceremonies of baptism and absolution, an oblation of bread and water, and a teaching of the resurrection. Symbolical representations were made of the passage of emancipated souls through the fixed stars. But little more is known of the service. The interesting point in the Mithraic rites is their resemblance, as attested by the Christian fathers, to the early Christian rites. This fact suggests a question which controversialists have not neglected — whether the Christians borrowed from the Mithraists or the Mithraists from the Christians, or whether the coincidences are casual. The mysteries of Mithra have also their analogues in the mysteries of ancient India; and it may be that the Christians yielded to the temptation to compromise in order to make the passage of conversion easier; as it is tolerably clear that they did in the appointment of a number of the church festivals. While these resemblances and relations must make this religion a matter of perpetual interest, its origin and nature are in fact "little less obscure than the caverns in which its mysterious rites were once performed. . . . That it was monotheistic in doctrine, and taught the belief in a future life; that it inculcated a code of morality, in which truth, justice, and temperance formed the principal virtues, is all that at present seems clear from the scanty evidence that remains of it."

The Sensations of freezing to Death.—The question, Is death from intense cold painless? is answered by a writer in "Chambers's Journal" from his own experience one day in the Pennine Alps. After a hot July climb to the snow-line, in which the traveler went out of his way in frequent excursions for beautiful objects, and did not eat, the sunset and the rapid change to intense cold took place. Poorly prepared to endure the transition, the writer felt a peculiar appearance in all his surroundings. "Everything looked hazy to my vision—even the snow and the rocks lying about looked as if enveloped in a fog, although the afternoon was beautifully clear. Then I felt that I must sit down and enjoy it; but the guide's flask of *Kirschwasser* set me going again. Very soon, however, the former feeling returned; but the same treatment temporarily recovered me. At last I took to stumbling along, fell down several times, and at length could not help myself. My companions urged me in vain to arouse to one more effort; but it was useless." Two monks from the hospice were brought to the rescue, and they and the guide "took me in hand, and, shaking me up, made my hands clasp a belt round the guide's waist, and each of the monks took an arm," and thus pulled him through the seven and a half miles to the hospice. "The sensations of that journey, during occasional gleams of consciousness," the writer continues, "will never be erased from my mind. Is there such an essence of ecstatic delight as *elixir*

mortis! If there is, it must have been something like it, or the very thing itself, which I enjoyed that day. No words can possibly express the surprising desire which I felt to sit down and enjoy my felicity—and sleep. But my inexorable friends knew that sleep meant death; and though my repeated appeals of 'Doucement, doucement!' were plaintive enough, they were met by redoubled efforts to force me onward, even when my own legs would not move any longer. . . . During the sustained efforts of the three men, I had but momentary glimpses of consciousness. I remember seeing two somethings, black, one on each side, but very indistinct. These, of course, were the friendly monks. The one overwhelming idea that filled my mind then was how to get to that sleep, that blissful euthanasia which poets have sung about, but which my companions were doing their best to rob me of, just when I had got it within my grasp." Hence it is concluded that death from intense cold may at all events be painless.

Half a Century of Railway Work.—Mr. Edward Woods, President of the English Institution of Civil Engineers, entered the service of the Liverpool and Manchester Railway Company more than fifty years ago. At that time the so-called "fish-bellied" rails were used, weighing thirty-five pounds to the yard, and were laid in iron chairs supported on stone blocks. Such beds proved too rigid, and were laid with heavier rails. Then wooden sleepers, being more elastic, were adopted instead of stone, and a wooden wedge, instead of an iron one, for holding the rail in the chair. The steel sleepers now coming into vogue in place of wood are so formed as to give great elasticity, and avoid the blunder of a rigid road. The essential characteristics of the locomotives, though great improvements have been made in them, have not been changed; but a wonderful economy has been effected in the consumption of coal. A larger traffic is now performed with three thousand one hundred tons of coke per annum than was then carried on with twelve thousand six hundred tons. The traction power of engines has increased fivefold, and inclines which were at one time considered too severe to be worked by locomotives are now easily surmounted. The average of speed has been increased considerably, but the maximum not greatly. In all the accessory details of railway work, such as signaling, switching, braking, etc., there has been a great and important advance.

Forestry in Switzerland.—While by the Constitution of 1874 the confederation has the right of supervision, each canton of Switzerland possesses in effect its own scheme of forestry organization. Two systems are prevalent, each of which has its advantages in certain circumstances. In the central, southern, and eastern parts of the federation, the territory of the cantons is portioned into districts of from 17,500 to 30,000 acres each, with an inspector and a number of trained foresters and keepers chosen by the owners of the woods, and paid by them. Each forester has about 3,000 acres under his care, and, under the control of the inspector, carries out the processes of cultivation, looks after the nurseries, clears rides, and disposes of the timber cut down. In the western and less rugged parts of the country, where the cantons have long possessed forest organizations, merely protective measures are subordinated to maintenance of a scientifically trained official staff. Most of the cantonal governments own forests which serve at once as models for the other forest proprietors and as an encouragement for the establishment of private staffs of keepers. In these cantons the superior forester does much that is left elsewhere to unskilled hands. The superior foresters are everywhere nominated and paid by the state, while the under-foresters are mostly selected and paid by the forest-owners. In most cantons forest administration is conducted by a department under the rule of a member of the government, assisted by a chief forester. The pay in all grades of the service is small.

Bean-Curd.—Tofu is a curd manufactured in Japan from beans, and, according to the "Journal of the Society of Arts," "approaches more nearly in its composition to animal food than any other vegetable known." It contains about one fifth of its

weight of fat, and nearly two fifths of nitrogenous matter. This would give it about double the nutrient value of beef. The Japanese prepare it by soaking the beans in water for twenty-four hours, then grinding them in a stone mill with the purest water obtainable, so as to form a thin pulp. The pulp is heated to boiling, when more water is added, and it is boiled again; then more cold water is added, and it is allowed to stand. The liquor is then strained out through a bag, and brine is stirred into it. This effects a coagulation, and the curd is pressed as in making cheese. Prof. W. Mattieu Williams has obtained soluble casein by treating peas in a similar manner; and he remarks that all peas and beans will yield soluble casein when so treated. Prof. Williams estimates the cost of producing the bean-curd, equal if not superior to the best cheese made in the dairy, at about threepence per pound.

Whaling in Spitzbergen Waters.—Whaling has been carried on in the Spitzbergen seas during the last forty years, according to Captain Gray, of the steamer Eclipse, of Peterhead, by the aid of the traffic in seals, with whose products the gaps in the cargo of whale-products were filled; but since the introduction of steam-vessels, in about 1860, the seals have been so completely exterminated that it no longer pays a vessel to go in search of them. Steam has also been to a great extent the ruin of the Greenland whale-fishing. The whales are receding farther and farther into the ice, where it is impossible to follow them. So far as can be judged, there are probably no fewer whales now than there were forty years ago, but they are more inaccessible, as they are being yearly frightened farther back by the noise of the steam-engines. Notwithstanding the greater difficulty in penetrating the ice at such a time, a "close season" is welcome to the whale-fisher, for the whale will only appear in the neighborhood of field-ice, and in open seasons the ice is constantly broken up by the swell. In some seasons the whales are later in appearing than in others; but the usual time is about the 20th of May, and from that time the fishing is prosecuted till about the end of June, when the whales disappear. A new branch of enterprise has been developed within a few years in fishing for the small "bottle-nose" whale. These whales yield no bone, but give about a ton each of an oil equal in lubricating power to the southern sperm-whale oil. Since they began to be hunted, more than two hundred have sometimes been killed in a season by a single ship; but there are signs that the trade is being overdone. The oils, formerly the main-stay of the fisheries, were at one time largely used for lighting collieries and street-lamps; but for a good many years back they have been principally employed by jute manufacturers for lubricating purposes. Since the discovery of the great Russian petroleum-wells at Baku, however, the demand for the seal and whale oils has greatly fallen off; but whalebone is now at a higher price than ever. Captain Gray regards the prospect of finding a new and lucrative whale-fishery in the antarctic seas as very hopeful.

Railways as Fosterers of Trade.—The history of railway construction in India illustrates in a remarkable way how rapidly traffic is developed as soon as facilities are opened for it. Until within a year or two past the Government of the country considered that it was unlikely that any railway in India would pay that did not pass through a dense population. The Government was averse to constructing railways in Burmah till business interest urged it so strongly that the experiment was tried, when, to the surprise of the administration, the Burmah Railway paid about five per cent as soon as it was opened. In the same way the Government denied the possibility of extensive traffic upon the Rajpootana and the Indus Valley railways, which were constructed solely for strategic purposes through a poorly populated country, and a narrow gauge was all that it would afford. Yet so rapidly has the country been brought under cultivation, and the population has increased so fast, that in 1885 the Indus Valley Railway carried one hundred and thirty-six million mile-passengers and two hundred and ninety-three million mile-tons of goods and grain, and paid 7·32 per cent on its capital; and the Rajpootana line carried three hundred and fifty-eight million mile-

passengers and three hundred and twenty-seven million mile-tons of goods and grain, and paid 6·97 per cent upon its capital.

Six Hundred Shots a Minute.—The Maxim machine-gun has a capacity for firing six hundred rounds a minute, or at least three times greater than that of any other machine-gun. It has only a single barrel, which, when the shot is fired, recoils a distance of three quarters of an inch on the other parts of the gun. This recoil sets moving the machinery which automatically keeps up a continuous firing at the extraordinary rate of ten rounds a second. Each recoil of the barrel has therefore to perform the necessary functions of extracting and ejecting the empty cartridge, of bringing up the next full one and placing it in its proper position in the barrel, of cocking the hammer, and pulling the trigger. The barrel is cooled with a water-jacket, is adjustable in every direction, and has a maximum range of eighteen hundred yards. The gun weighs only one hundred and six pounds; it can be taken apart, folded up, and put together again, the latter operation being possible in ten seconds.

NOTES.

How timber can be intelligently cultivated on farm-lots of from sixteen to twenty acres was explained by Mr. Benjamin Hathaway at the Michigan Forestry Convention. While the timber is young the ground can be used for pasture, and even for wheat and oats. After the shade has grown dense, the temporary value of the land is reduced; but in eight or ten years afterward the timber becomes marketable. Trees planted in border screens, ten feet apart, will support a wire fence, afford a supply of fire-wood from their trimmings, and add positively to the attractiveness, value, and profitable cultivation of the farm.

THE French Association met this year in March, at Oran, in Algeria. M. Laussedat was chosen president, and delivered an address on the civilizing influence of science. The meeting was held in the spring instead of the summer, on account of climatical considerations. One previous meeting of the Association—that of 1881—was held in Algeria.

THE great Bressa prize of 12,000 francs, or $2,400, has been awarded to M. Pasteur by the Academy of Sciences at Turin.

MR. VINCENT JACKSON, senior surgeon of the Wolverhampton and Staffordshire General Hospital, who is also Mayor of Wolverhampton, presided recently at a "Burial Reform" meeting, and defined the reforms required to be: coffins of the most perishable and lightest material, all lasting substances being rejected; interments as early as possible; the pall to be discarded as an unnecessary and baneful covering, and burial in plain earth with total disuse of vaults and bricked graves. Vaults were condemned by Dr. Malet, medical health-officer for the borough, as tending to the spread of disease, and injury to the health of persons attending burials.

A COLLECTION of objects relating to religion—altars, priests' robes, and kindred objects—made in the course of several years by M. Guimet, was some time ago presented by him to the municipality of Paris on condition that a building should be specially devoted to them. The building, which is close to the Trocadéro Palace, has just been finished, and will shortly be occupied as a museum of religions.

"RAILWAY-BRAIN" is a term applied by Dr. Thomsen to a neurosis or general derangement of the nerves produced by a shock received by the head on a railway-car. In the particular case described, no wound was received, and consciousness was preserved at the time of the injury. Afterward the patient became melancholic, and complained of insomnia, headache, spinal pain, weariness, and failure of appetite. A hygienic and palliative treatment was given.

AN interesting experiment was recently made by a Dr. Durand, in reference to the relative power of imagination in the two sexes. He gave to one hundred of his hospital patients a dose of sweetened water, and shortly afterward entered the room, apparently greatly agitated, saying he had by mistake administered a powerful emetic. In a few minutes four fifths of the subjects were affected by the supposed emetic, and were mainly men, while every one of those not affected were women.

M. BONNETOUD, a French engineer, employs the explosive force of dynamite to drive out, for a brief period, the water from portions of wet ground in which foundations are to be made. A hole is bored in the wet ground, ten or twelve feet deep, and about an inch and a half wide. By exploding cartridges of dynamite in this hole the water is driven far out beyond the sides of the yard-wide cavity which is produced, and does not reappear till after half an hour at least. The workmen thus have time to clear the cavity and introduce quickly-setting concrete.

THE deleterious effect of arsenic upon the skin was recently discussed in the Pathological Society of London, after a communication by Mr. Jonathan Hutchinson. The skin is the tissue on which arsenic has perhaps its most marked influence. The poison may spoil the complexion instead of improving it, by making it muddy and unsightly. A similar action is exhibited in all parts of the skin, and may lead to the development of soft corns, not warts, in the palms of the hand and soles of the feet, where a roughened condition also grows up under its influence. Mr. Hutchinson expressed the belief that arsenic can produce epithelial cancer.

ASSUMING that the coincidence of the earth's perihelion passage with the summer solstice every twenty-one thousand years marks the regular recurrence of a northern glacial period, M. Adolphe d'Assier has calculated that the last glacial period reached its culmination in 9250 B. C., and that the alternating period of greatest warmth in the northern hemisphere occurred A. D. 1250, after which we immediately began to move toward the next glacial period, which will reach its height in, say, A. D. 11,750. Hence the north must have been growing cooler during the last six hundred years. Evidence is not wanting, M. d'Assier asserts, in changes that have been observed in the northern limits of growth and ripening of certain plants, that this has been the case, and he names several instances.

DR. R. W. SHUFELDT, in a paper on Dr. Thomas H. Street's collection of birds' sterna and skulls, mentions as a fact long well known to him, which is illustrated by specimens in the collection, that there are a great many species of North American birds that gradually increase in size as we pass from the southern parts of the country toward the north.

THE Congo in the neighborhood of Stanley Falls, according to the account of an English engineer formerly in the service of the Free State, is so full of islands that an uninterrupted view from bank to bank is obtained at only three or four points. The misleading statement, without mention of the islands, that both shores are seldom visible at the same time, has given rise to mistaken and exaggerated ideas of the size of the river. The great plain, some five hundred miles in extent, through which it runs here, is covered for the most part with dense tropical jungle, abounding in rare and valuable forms of plant-life. Tree-ferns, and many varieties of orchids yet undescribed, are common, as well as the wild coffee shrub, several kinds of plants yielding India-rubber, mahogany, and other splendid timber-trees.

A CURIOUS combat between two hawks and an owl is described in Major-General Newhall's "Highlands of India." The three birds first performed a preliminary series of upward gyrations, each endeavoring to get a position of advantage above the other. Finally one of the hawks made good his stroke, and both birds fell to the ground like a stone. When the author rode up, the little hawk was standing in the attitude of a conqueror on the owl's body, whose head he had twisted off and held in his claw.

THE world consumes annually, according to an English authority in the trade, about 650,000 tons of coffee, and produces a corresponding quantity. Estimating the average price at $400 a ton, this represents a value of $260,000,000. Jamaica coffee is the finest grown, but only furnishes about 5,000 tons. East Indian and Ceylon coffees are of very high quality, but they do not together produce more than 25,000 tons. The Ceylon crop used to be more important than it is, but has been reduced in consequence of a disease of the plants. The average crop of Java is from 60,000 to 90,000 tons, and that of Brazil from 340,000 to 380,000 tons. Costa Rica and the other Central American states also export coffee.

WHILE it appears from the records of English health officers that some diseases have special seasons in which they are most likely to prevail, it is not shown that occasional variations in temperature have much influence in the matter. Scarlet fever is at its minimum from January to May, and at its maximum in October and November. Diphtheria is more evenly distributed through the year, and is most dangerous a little later than scarlet fever. Measles and whooping-cough seem to be somewhat aggravated by cold weather, but are most fatal in May and June. Hot weather is adverse to small-pox, and favorable to disorders of the bowels, particularly in children.

RUNNING to catch trains is declared to be dangerous, not only on account of the immediate perils it involves, but also because it tends in the long run to shorten life. We—at least persons who have passed middle age—have only a certain amount of reserve force, and all that we draw upon in hurries is abstracted from that which should be distributed through the remainder of life. The secret of longevity is probably skill in so economizing the reserve of vital energy as to make it last out an unusual period. Persons who begin unusual exercises in youth may adapt their constitutions to the habit, and may thereby hold on to their full term of life; but this can not be done safely if one waits till mature age before beginning.

Dew is known to play an important part in the growth of plants by furnishing them and the surface of the soil with moisture. In hot and rainless countries and seasons, in fact, plants would not be able to reach maturity were it not for the dew which supplies the deficiency of rain. According to M. Prillieux, dew plays another and mischievous part in promoting the growth of parasitic fungoids, whose spores, brought by the wind, owe to it their power to germinate on the plants on which they light.

A committee of the English Medical Council has been appointed to consider the best means of increasing the practical element in medical education. Although the strictly scientific parts of medicine are taught as they never have been taught before, it is conceded that there has been a falling off in the practical part, and that the new graduate, although more learned in minute anatomy, chemistry, and physiology than his predecessors, is less apt at recognizing and treating common diseases.

The capacity of magnesia to form a cement, long known, has been regarded from a practical point of view since the residues and sub-products of the Stassfurt potash manufacture have risen to commercial importance. Dr. Frank's cement of magnesia and chloride of magnesium was unfortunately liable to the objection of swelling and breaking up, like some of the lime-cements, in consequence of slow hydration. Dr. Grundman, of Hirschberg, has patented a new process, in which, instead of calcining the magnesia and treating it with water, he makes a carbonate of it by exposing it to carbonic acid as produced by the burning of coke in close apartments. It thus forms a substance as hard as magnesite and capable of taking on a fine polish. Mixed with marble-dust, it forms an artificial dolomite; and, with soluble silicates, an artificial stucco.

Experiments with an electric locomotive are now being made on one of the underground roads in London, which, if successful, will do away with the chief annoyance of underground travel, the smoke, and the danger incident to carrying a powerful electric current along the line will be very much lessened on the underground system.

Dr. R. W. Shufeldt has made measurements of the leaps of the Mexican hare (*Lepus callotis callotis*) and the sage-hare or rabbit (*L. Sylvaticus Nuttalli*) on the snow-covered plains of New Mexico, the animals having been stimulated by a scare from the shot of a fowling-piece. The Mexican hares cleared twelve and thirteen feet, while the Mexican rabbits could leap fully six feet, and, in one case, more than seven feet. At their common rate of going, he says, "the hare rarely clears more than four feet at any single leap, while the rabbit is satisfied with rather more than two feet, and, when quietly feeding about the sage-bush, the tracks made by an individual of either species may actually overlap each other."

The Municipal Council of Paris intends to found, in connection with one of the prominent public institutions, a chair of Philosophical Zoölogy, with a special view to the propagation of the Darwinian doctrine of evolution. Among those who are named as probable occupants of this chair, the fittest is said to be M. Alfred Giard, late of Lille, but now of Paris, who has taught this doctrine and made researches regarding it, and has gathered around him a school of young zoölogists.

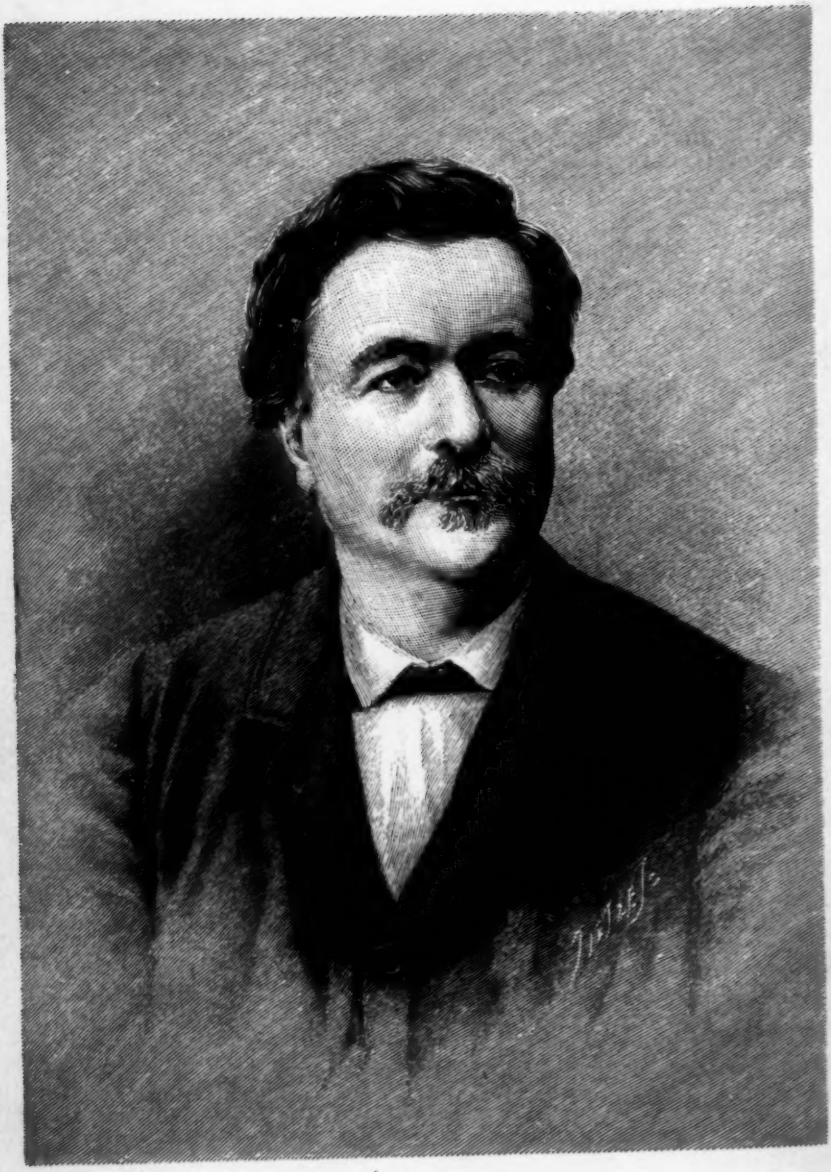
A writer in "Chambers's Journal" has suggested that, if school-prizes are to be continued, their character might be improved, and they might be made to contribute to real zeal in the pursuit of knowledge, and to become a stimulus to further effort, by giving a part of their value, at least, in the form of privileges of free tuition in some school where the recipient's favorite branches could be studied for a longer time and to greater proficiency; while a smaller part might still be applied to the provision of a medal, as visible evidence of the merit and distinction.

OBITUARY NOTES.

Dr. Maximilian Schmidt, an eminent geologist, and Director of the Zoölogical Gardens at Berlin, has recently died, at the age of fifty-four years.

Prof. Hans Carl Frederick Christian Schjellerup, the Danish astronomer, died at the Copenhagen Observatory, November 13th. He was born in 1827, distinguished himself in mathematics at the Polytechnic School in Copenhagen, was appointed observer in the old observatory at Copenhagen in 1851, and succeeded to the new one when it was completed. He determined the orbit of the comet of 1580, made zone observations of the stars between 15° of north and 15° of south declinations, translated Sufis's descriptions of the fixed stars from the originals, contributed to the journal "Copernicus" articles on the astronomy of the ancients, and published a catalogue of the "red stars."

Admiral Sir Astley Cooper Key, of the British Navy, died March 3d, in the sixty-seventh year of his age. He had during his service held the positions of Principal Naval Lord of the Admiralty and Director of the Royal Naval College, and had done much in behalf of the application of science to the wants of the navy.



PAUL BERT.